W72-10609

WATER POLLUTION CONTROL RESEARCH SERIES 16060 EVT 08/71

W72 10609

PB 210 708

Pesticide Inputs and Levels Minnesota Waters--Lake Superior Basin

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U.S. ENVIRONMENTAL PROTECTION AGENCY

105

WATER POLLUTION CONTROL RESEARCH SERIES

The Water Pollution Control Research Series describes the results and progress in the control and abatement of pollution in our Nation's waters. They provide a central source of information on the research, development and demonstration activities in the Environmental Protection Agency, through inhouse research and grants and contracts with Federal, State, and local agencies, research institutions, and industrial organizations.

Inquiries pertaining to Water Pollution Control Research Reports should be directed to the Chief, Publications Branch (Water), Research Information Division, R&M, Environmental Protection Agency, Washington, D.C. 20460.

SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

1. Report No. 2. W72-10609

PESTICIDE INPUTS AND LEVELS: MINNESOTA WATERS--LAKE SUPERIOR BASIN,

5. Report Date
6.
8. Performing Organization Report No.

[redacted] A.

16050 EYT 6/71

Minnesota Pollution Control Agency, Minneapolis

13. Type of Report and Period Covered

12. Sponsoring Organization

Environmental Protection Agency, Water Pollution Control Research Series [redacted] June 1971. 108 p. 8 fig., 42 tab.

Concern about pesticide accumulation in the Upper Great Lakes prompted studies along Lake Superior's North Shore to provide current information on pesticide levels and contamination. Water samples were analyzed from the Grand Marais, the Duluth Pumping Stations, and the Duluth sewage treatment plant. Clams were exposed for bioassay purposes in 22 streams because they are concentrators of toxic substances, including chlorinated hydrocarbons, and reveal DDT and related compounds present in amounts below detection by ordinary analytical procedures. Under normal flow conditions, very little insecticide contamination was being contributed to Lake Superior from the drainage basin. Highest values occurred in the Lester and Lower St. Louis Rivers and in sewage effluent; in October, following heavy runoff, p,p'DDT reached concentrations of 20-21.8 ppb. Medians in all other streams were less than 0.01 ppb. p,p'-DDT was present in greater concentrations than its o,p'-DDT isomer or DDE. p,p'DDT values exceeded the median in four streams only. Native clams from the St. Louis River, with a resident time of 5-11 years, had accumulated appreciable concentrations of p,p'DDT ranging from 93 to 1630 ppb. It is recommended that the St. Louis River be monitored at reasonable intervals. (Jones-Wisconsin)

17a. Descriptors

*Pesticides, *Minnesota, *Lake Superior, *Watersheds (Basins), Water pollution sources, Bioassay, Sewage effluents, Runoff, Monitoring, Sampling, DDT, DDE, Rivers, Chlorinated hydrocarbon pesticides, Flow

17b. Identifiers

Duluth (Minn.)

17c. COWRR Field & Group

05C, 02H

Copy available from GPO Sup Doc [redacted], $1.00 ; microfiche from NTIS as PB [redacted], $0.95.

18. Availability

19. Security Class. (Report)

20. Security Class. (Page)

21. No. of Pages

22. Price

Send To:

WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U S DEPARTMENT OF THE INTERIOR
WASHINGTON D C 20240

E. S. Jones ya

Wisconsin Univ, Madison

PESTICIDE INPUTS AND LEVELS
MINNESOTA WATERS - LAKE SUPERIOR BASIN

by

Minnesota Pollution Control Agency
717 Delaware St. South East
Minneapolis, Minnesota
55440

for the

ENVIRONMENTAL PROTECTION AGENCY

Program #16050 EYT
June, 1971

ih

EPA Review Notice

This report has been reviewed by the Water Quality Office, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.00

ABSTRACT

Field and laboratory studies were conducted to determine whether North Shore streams in the Minnesota drainage basin of Lake Superior were important as contributors of insecticides. Samples were collected and analyzed from selected streams, the Grand Marais and Duluth Pumping Stations, and the Duluth sewage treatment plant. Clams were exposed for bioassay purposes in 22 streams.

Under conditions of normal flow, very little insecticide contamination was being contributed to Lake Superior by these streams. Highest values occurred in samples from the Lester and Lower St. Louis Rivers and in sewage effluent. In October, following heavy runoff, PP' DDT reached concentrations of 20-21.8 ppb. Ordinarily, median levels in these rivers were 0.03 and 0.02 ppb, respectively. Medians in all other streams were less than 0.01 ppb. Almost invariably PP'DDT was present in greater concentrations than its OP' isomer or DDE.

In the clam studies PP'DDT values exceeded the median in four streams only. Native clams from the St. Louis River, with a resident time of 5-11 years, had accumulated appreciable concentrations of PP'DDT. Values ranged from 93 to 1630 ppb.

On this basis, it was recommended that the St. Louis River be monitored at reasonable intervals.

CONTENTS

Section		Page
I	Conclusions	1
II	Recommendations	3
III	Introduction	5
IV	Selection of Sampling Sites	7
V	Laboratory Procedure for Water Samples	11
VI	Laboratory Procedure for Clam Samples	13
VII	Gas Chromatography Analysis	15
VIII	Results - Water	17
IX	Results - Clams	19
X	Acknowledgements	21

FIGURES

		PAGE
1	SAMPLING SITES - NEMADJI RIVER TO FRENCH RIVER	23
2	SAMPLING SITES - FRENCH RIVER TO BAPTISM RIVER	25
3	SAMPLING SITES - MANITOU RIVER TO CASCADE RIVER	27
4	SAMPLING SITES - DEVIL TRACK RIVER TO PIGEON RIVER	29
5	TYPE OF BASKET USED IN BIOASSAY STUDIES	31
6	NORTH SHORE STREAMS - THE TEMPERANCE RIVER	31
7	NORTH SHORE STREAMS - THE CASCADE RIVER	33
8	NORTH SHORE STREAMS - THE SPLIT ROCK RIVER	33

TABLES

No.		Page
1	Water Analysis - Pigeon River	35
2	Water Analysis - Brule River	36
3	Water Analysis - Baptism River	37
4	Water Analysis - Grand Marais Pumping Station	38
5	Water Analysis - Beaver River	39
6	Water Analysis - Knife River	40
7	Water Analysis - Duluth Pumping Station	41
8	Water Analysis - Lester River	42
9	Water Analysis - Upper St. Louis River	43
10	Water Analysis - Lower St. Louis River	44
11	Effluent Analysis - Duluth Sewage Plant	45
12	Water Analysis - Upper Nemadji River	46
13	Water Analysis - Lower Nemadji River	47
14	Summary of Field Operations - Clams	48
15	Experimental Clam Results - Pigeon River	50
16	Experimental Clam Results - Reservation River	52
17	Experimental Clam Results - Brule River	54
18	Experimental Clam Results - Devil Track River	56
19	Experimental Clam Results - Cascade River	57
20	Experimental Clam Results - Poplar River	59
21	Experimental Clam Results - Temperance River	60
22	Experimental Clam Results - Manitou River	61
23	Experimental Clam Results - Baptism River	63

TABLES (Continued)

No.		Page
24	Experimental Clam Results - Beaver River	65
25	Experimental Clam Results - Split Rock River	67
26	Experimental Clam Results - Gooseberry River	69
27	Experimental Clam Results - Encampment River	70
28	Experimental Clam Results - Stewart River	71
29	Experimental Clam Results - Knife River	72
30	Experimental Clam Results - Big Sucker	74
31	Experimental Clam Results - Schmidt Creek	77
32	Experimental Clam Results - French River	79
33	Experimental Clam Results - Talmadge River	81
34	Experimental Clam Results - Lester River	83
35	Experimental Clam Results - Upper St. Louis River	85
36	Experimental Clam Results - Lower St. Louis River	87
37	Experimental Clam Results - Upper Nemadji River	88
38	Experimental Clam Results - Lower Nemadji River	89
39	Control Clam Results - Mississippi River	91
40	Native Clam Results - Upper St. Louis River	95
41	Summary of Age, Weight and Species - Clams	97
42	Median Values of Pesticides in Clams	103

SECTION I
CONCLUSIONS

1. Very little pesticide in terms of DDE and OP'or PP'DDT is currently being added to Lake Superior by North Shore streams.

2. On the basis of clam studies, there is evidence that the St. Louis River is contributing such pesticides in small amounts.

3. Clam bioassays also indicate, although not as clearly, that the Beaver and Brule Rivers may at certain times carry small amounts of pesticide.

4. In the St. Louis River, water sampling results support the findings made in a study of exposed and native clams.

5. In other streams such as the Nemadji, Lester, Brule, Knife and Beaver Rivers results indicate that one may expect small pesticide contributions on an intermittent basis, especially following runoffs produced by heavy rains.

6. Another potential source of insecticides on an intermittent basis is the Duluth Sewage Treatment Plant effluent.

7. Looking to the future, if in the drainage area which has been under study pesticide use is kept at or below its present level, there need be no great concern relative to the amounts of chlorinated hydrocarbons such as PP' and OP' isomers of DDT and DDE being carried into Lake Superior by North Shore streams.

8. In the St. Louis River, however, based on the findings obtained in clam studies as well as by water examination, one cannot ignore the fact that chlorinated hydrocarbons have been found in appreciable amounts. It is suggested that this stream should be routinely monitored, at reasonable intervals.

SECTION II
RECOMMENDATIONS

This study was based on field observations and laboratory analyses to detect the concentration of certain chlorinated hydrocarbons in water from and in clams exposed to waters of selected streams tributary to Lake Superior from its Minnesota drainage basin. No consistently high levels of chlorinated hydrocarbons were recovered from these waters or from clams exposed in the streams. Only one stream, the St. Louis River, could be pointed to as carrying an appreciable load of the DDT isomers or DDE on either an intermittent high level or a constant low level basis.

It is recommended that the St. Louis River be monitored at reasonable intervals including periods of high as well as low run-off.

Preceding page blank

SECTION III
INTRODUCTION

By providing the means whereby the vectors of human disease may be controlled and whereby the necessary crops and food calories may be provided for our ever increasing population, the "persistent insecticides" have conferred tremendous benefits on mankind. Our society therefore owes a debt to these agents. However, as we look into the future we soon realize that this happy association has a number of unfortunate aspects, which in the early use of these insecticides was not immediately or fully appreciated. For example, the persistent quality which made these agents especially good for insect control is often a distinct disadvantage since the poison, after destroying the pest, remains to endanger man himself. In addition, the development of resistance to the pesticides by the target insect and the excessive broadness of the lethal effects which characterize these agents and extend their toxicity to beneficial insects and other useful organisms, are factors which seriously limit their usefulness. Thus while our needs for insecticides and other pest control chemicals will continue to increase, if we are to feed and clothe our world population, there is evidence that we must become extremely concerned about the unintentional effects of pesticides on human health and on various life forms important to the survival of man.

In December 1969, when the U.S. Department of Health Education and Welfare published a voluminous 677 page document entitled "Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health", it effectively recognized and pointed out to the American public the importance of pesticides to the welfare and well-being of man. This report included references to some 5,000 published articles or ongoing scientific research projects dealing with pesticides which had been reviewed and evaluated by the commission and which had been used as a basis for their recommendations. In a partial summation they stated: "After carefully reviewing all available information, the Commission has concluded that there is adequate evidence concerning potential hazards to our environment and to man's health to require corrective action. Our nation cannot afford to wait until the last piece of evidence has been submitted on the many issues related to pesticide usage. We must consider our present course of action in terms of future generations of Americans and the environment that they will live in."

In the above report there were also included certain special Advisory Panel Reports on carcinogenesis, interaction, mutagenesis and teratogenesis. In connection with these and as an over all statement relative to their general philosophy the commission further stated: "We must consider the total problem of pesticide usage not only in the context of what is presently known but also in the context of the many unknowns still to be determined. Corrective action is recommended now to prevent further environmental contamination from pesticide residues and to protect the health of man."

Preceding page blank

In the month of April 1969, the month which D.H.E.W.'s Secretary Finch appointed his commission on pesticides and environmental health, the upper Great Lakes Governor's Conference on Pesticides stated that it was their wish that the recommendations of the Lake Michigan Enforcement Conference be immediately and fully implemented. It was further recommended by that conference that the studies on pesticides be expanded to include the Minnesota and Wisconsin drainage basins of Lake Superior and to the Michigan drainage basin of Lakes Superior and Huron. Like the secretary's commission the Governors were greatly concerned over the possible hazards presented by increasing residual pesticides in the environment generally and they were especially concerned over the possibility that in the Upper Great Lakes these pesticides might be reaching levels which could be considered a threat to the health and well-being of the people of their respective states. As a consequence a further recommendation of their conference report was that a monitoring program be initiated and that special studies be made to provide current information on pesticide levels and pesticide contamination within the aquatic ecosystems of the lakes, especially Lake Michigan. The Minnesota study reported here represents one of the phases of this undertaking as it was carried out along the North Shore of Lake Superior.

As indicated by its title, the latter study has been limited to Minnesota waters and to the tributary streams of the Minnesota drainage basin of Lake Superior along its north shore. Briefly stated, the study has been concerned with monthly observations on pesticide levels of waters from 12 key points between the Canadian border and Duluth, with observations on pesticide levels in sewage effluents in the Duluth area and with a biological assay type of study in which the pesticide levels of exposed "captive" clams and native clams have been determined. In the latter study mature clams from an outside source were exposed for varying lengths of time in some 20 North Shore streams and in the St. Louis and Nemadji Rivers. Collections of the exposed clams were made at intervals of two weeks in such a way that some specimens were exposed for the entire period of the study, June to December inclusive. The final collections were made during a snowstorm, December 11th, just before the complete "freeze-up" of the North Shore streams occurred. Clams were used in this biological study because they are plankton and detritus feeders and are demonstrated concentrators of many toxic substances in water, including chlorinated hydrocarbons. On this basis they should reveal the presence of DDT and related compounds in amounts below detection by ordinary analytical procedures such as thin layer and gas chromatography.

SECTION IV
SELECTION OF SAMPLING SITES

Prior to any activity in connection with the field aspect of the study dealing with pesticide inputs and levels in Minnesota waters of the Lake Superior basin, all major rivers along the North Shore of the lake were visited to determine satisfactory sampling sites. These observations regarding suitability were also extended to the St. Louis and Nemadji Rivers. While it would have been preferable to have located all sites as near to the mouths of the rivers as possible, this was not always feasible for a variety of reasons such as inaccessibility to the stream because of precipitous rocky banks, that the area was too exposed to casual tourist traffic, or that it was too close to adjacent private homes. It was also necessary, in locating sites for clam exposure, to anticipate fluctuations in the water level so that the clams would not be exposed when the level of the streams dropped. Consequently, the sites which were finally selected were, for the most part, some distance upstream in order to reduce the possibility of vandalism. Following is a listing of the rivers used in the study together with a brief description of the sites where water samples were taken and where the clams were held (See Figs. 1 - 8).

Pigeon River	200 yards below the old port of entry into Canada
Reservation River	200 feet upstream from the bridge on Highway 61
Brule (Arrowhead) River	just below the Magney Memorial
Devil Track River	2 miles upstream, just above the point of crossing of the Gunflint Trail
Cascade River	One mile upstream from Highway 61
Poplar River	1/8 mile upstream from Highway 61
Temperance River	6 miles upstream from Highway 61 and off the Sawbill Trail
Baptism River	three miles up State Highway 1
Beaver River	1/8 mile above Highway 61, just off a spur of State Highway 4
Manitou River	approximately 400 feet above the bridge on Highway 61
Split Rock River	approximately 400 feet above the bridge on Highway 61, bridge on west bank

Reproduced from best available copy.

Gooseberry River	¼ mile upstream on the north side
Encampment River	just below the bridge on Highway 61
Stewart River	approximately 300 feet upstream from Highway 61 bridge
Knife River	3/4 mile upstream
Sucker River	¼ mile upstream from bridge on Highway 61
Schmidt Creek	approximately 300 feet above barricade in stream, off Highway 61
French River	1/8 mile upstream from the Old North Shore Road
Talmadge River	approximately 1/8 mile upstream from Highway 61 bridge
Lester River	1½ miles upstream from Highway 61
Upper St. Louis River	½ mil above Highway 2 bridge above Cloquet
Lower St. Louis River	just off Billings Park, Superior, Wisconsin
Upper Nemadji River	near point where County Road C crosses river
Lower Nemadji River	just downstream from suspended pipeline

The baskets in which the clams were held in the streams measured 16 x 12 x 10½ inches and were constructed of light gauge steel rod similar to milk bottle carriers in use some years ago. Since the clams would be unable to move out of the site once the baskets were placed in position and thus would be in danger of being silted over if placed in the bottom of the large containers, smaller baskets were fabricated from hardware cloth and the clams were placed in these. The small baskets were then wired in a suspended position within the larger container (Fig. 5). The latter was finally attached by a long wire lead to a convenient tree, bush, or boulder in the water or on the adjacent bank.

The clams used in the investigation were collected by SCUBA diving from the Mississippi River near Deer River, Minnesota. During the months of May and June, 523 clams were "planted" in 24 streams. Fifty-one of the

clams taken from the Mississippi River were set aside as controls, frozen immediately, and sent to the State Health Department for analysis for pesticide content.

As the first approach to the "planting" of clams, four specimens were placed in each of the following streams on May 8: Pigeon, Baptism, Beaver, and Knife. On May 22, 24, and 26, five additional clams were added to the following streams:

Pigeon	Temperance	Stewart	Talmadge
Reservation	Baptism	Knife	Lester
Devil Track	Beaver	Big Sucker	St. Louis
Cascade	Manitou	Schmidt Creek	Nemadji
Poplar	Split Rock	French	

Fifteen additional clams were placed in the baskets in each of the above-named streams on June 13 and 14. Fifteen clams were also placed in two additional streams, namely the Gooseberry and Encampment Rivers, as well as in two sites in the St. Louis and Nemadji River. Thus, in the latter rivers, two locations were utilized, the upper and lower St. Louis and the upper and lower Nemadji.

Beginning on June 22, each river was visited once a week to inspect the sites for possible vandalism and to determine the level of water in the streams. Every two weeks, commencing on June 29, each site was visited for the purpose of collecting one clam from each river for analysis. These routine visits and collections were made by Mr. Daniel Engstrom, a senior Biology major at the University of Minnesota, Duluth, who, in the performance of his duties, travelled in excess of 17,000 miles between May and December, 1970.

Water samples were taken once a month from 13 stations, beginning May 9, from each of the clam sites in the Pigeon, Beaver, Brule, Baptism, Knife, St. Louis, and Nemadji Rivers. Samples from these streams were specifically requested by the Minnesota Pollution Control Agency. The investigators added the Lester River and one additional station in each of the St. Louis and Nemadji Rivers. The last water samples were taken during the first week in December from all streams except the Pigeon; the last sampling from this stream was on November 1, 1970. Attempts to reach the site in December were made impossible by blizzard conditions which prevailed and which subsequently made the road impassable.

Collection of water samples was made by immersing 5-liter bottles in the streams adjacent to the clam baskets. After filling, the bottles were capped with screw tops lined with aluminum foil, transported to the Department of Biology, University of Minnesota, Duluth, and held in a constant-temperature room (40° F.) until they could be shipped to the State Health Department for analysis.

Three additional water samples were collected according to the time-table used for stream sampling. These were from the pumping stations at Grand Marais and Duluth (untreated water) and a chlorinated sample of effluent from the Duluth Sewage Disposal Plant.

All samples were analyzed for the presence of pesticides as well as for suspended solids, suspended volatile material, and for turbidity.

SECTION V
LABORATORY PROCEDURE FOR WATER SAMPLES

Analysis of the water samples was by gas chromatography and the methodology followed in the preparation of samples for analysis was as follows: Water samples were collected in clean glass containers since plastic readily absorbs pesticide from the water. After collection, samples were kept cool until the laboratory analysis could be carried out. In the laboratory a liter aliquot of the sample was removed and acidified with 10 ml of HCl (1:1 HCl - H_2O). The water sample was then placed in a large separatory funnel and extracted with chloroform. At each extraction the funnel was shaken vigorously for at least one minute before separation. Four extractions were made, the first with 100 ml and the others with 50 ml each, a total of 250 ml of chloroform. After each extraction and after the phases had separated the chloroform layer was drained away into a beaker.

The extracts from the above procedure were percolated through a chromatographic column packed with four inches of anhydrous sodium sulphate to remove residual water. When all four extracts had been passed through the column it was washed with several portions of fresh chloroform. The combined (sulphate dried) chloroform extracts were then evaporated on a steam bath to a final volume of approximately 5 ml. This concentrate was next transferred to a 15 ml centrifuge tube and three rinses of petroleum ether, each consisting of one to two ml, were used to insure quantitative transfer. After each rinse the solvent was evaporated to dryness under a slow current of clean dry air. The residue was then taken up in a measured volume of benzene or hexane from which an aliquot was withdrawn and injected in a gas chromatograph for final analysis.

SECTION VI
LABORATORY PROCEDURE FOR CLAM SAMPLES

Analysis of the clams, like water samples, was by gas chromatography. However, the procedure for preparing the material for analysis was somewhat more elaborate. The following protocol details the method used:

Early trials indicated that the best procedure for killing the clams and keeping them in good condition until an analysis could be made, was that of freezing. As a consequence all specimens were promptly frozen after collection and kept frozen until they were delivered to the analytical laboratory. When the analyst was ready to undertake his examination the clams were thawed at room temperature and the contents of the shell removed. The full body weight of the clam, minus its shell, was then determined and recorded for each specimen. Shells which had been removed were marked so that each could be examined later to ascertain the species, age and relative size of each clam. By this procedure body weight could also be associated with the other findings.

Next the entire clam, exclusive of its shell, was placed in a blender and ground up. If the total weight was 25 grams or more only a 15 gram aliquot was removed from this ground slurry for the extraction procedure which followed. During the grinding process, anhydrous sodium sulphate was added to take up the water released. Also, it was found that the sodium sulphate served as an abrasive which facilitated the grinding process. Enough anhydrous sulphate was added so that the final mixture did not clump. After its removal from the well mixed total sample, the 15 gram aliquot was placed in an Erlenmeyer flask and a measured amount of extraction solvent was added. This solvent was made up of a mixture of acetone-hexane (4:1) and enough was added to the flask to completely cover the clam and anhydrous sodium sulphate mixture.

After standing for at least 24 hours, with occasional shaking, the fluid portion of this mixture was filtered off into a graduated cylinder. The amount recovered was recorded.

The solvent from the graduate was then evaporated to near-dryness on a steam bath and placed on a column of "Activated Florisil" for additional refinement. The Florisil column which was 4 inches long, was topped with ½ inch of the anhydrous sodium sulphate drying medium. After the sample had been placed on the column described it was eluted with a petroleum ether-diethylether mixture (19:1). The eluant from the column was collected in a beaker and evaporated to dryness on a steam bath. The dried residue was then taken up in fresh petroleum ether, using three 2 ml portions, and transferred to a centrifuge tube. When necessary the residue extract could be stored in this form until the chromatographic analysis could be made. Whether held for subsequent analysis or for immediate processing, the final step consisted in the complete evaporation of the petroleum ether to leave another dry residue which could be taken up in an appropriate known amount of hexane. This

Preceding page blank

final hexane solution was the material which was actually injected directly into the sample port of the gas chromatograph for the identification and quantitation of any chlorinated hydrocarbons the clams may have contained.

In the foregoing description of the sample preparation reference is made at one point to "Activated Florisil" and a note of clarification is probably needed. The term activated simply means that the Florisil which is being used for the clean-up part of the procedure in preparation of samples has been subjected to a special treatment to make it effective. In this instance the Florisil was activated by heating in an oven at 650°C for three hours, followed by twelve hours at 130°C. When cooled, water (5% by weight) was added to the powder which was then allowed to stand for 24 hours before use. To insure consistency in its activity the Activated Florisil was stored in sealed containers.

SECTION VII
GAS CHROMATOGRAPHY ANALYSIS

Gas chromatography, which has been largely developed since 1951, and which represents a powerful analytical tool for the separation of gaseous and volatile substances, is admirably suited to the identification and quantitation of chlorinated hydrocarbons. In this analytical procedure the substance to be identified and measured is converted into a gaseous state or dissolved in a volatile liquid which is converted to vapor, and injected into a carrier gas passing through a specially designed column. This column contains a solid adsorbent or a liquid adsorbent supported on an inert solid. When a liquid adsorbent is used the differences in the partitioning coefficients for the gaseous components passing through the column is the basis for separation, whereas when solid adsorbents are used it is the differences in adsorption coefficients which are important. In the type of analysis used here, namely "elution analysis" solid adsorbents are not widely used because gases are quickly adsorbed but are slowly desorbed. Since they are given off slowly they produce elution peaks on the recorder which have sharp fronts and tailing backs. Instead of solid adsorbents, partition columns were used in these studies. These columns have liquid adsorbents which produce symmetrical elution peaks so that the area under each peak can be estimated by measuring peak height alone or better by multiplying the peak height by half its bandwidth.

Samples are introduced into the column of a gas chromatograph by a hypodermic syringe, the needle of which is forced through a piece of self sealing material near the column entrance. The sample introduced is usually small, 0.01 to 0.1 ml of volatile liquid. Columns are about ¼ inch in diameter and one to several meters in length. Columns which can be used for chlorinated hydrocarbon and pesticide analysis are commercially available. Two such columns are identified as SE-30 and CV-17.* Since the components of the injected sample are carried down the column at a rate which varies inversely according to the affinity of each for the adsorbent material on the column, the time of appearance at the detector is a characteristic of each (establishing its identity) and the area under each peak is a measure of its concentration.

It would appear that the primary requirement of a gas chromatograph is that it adequately separates the components of a sample. However, separation alone is not enough; one must also be able to identify the peaks. This check can be made by carrying out various supplementary types of wet-bench analysis or by injecting separately the test solution, a known standard and a mixture of the latter two into a second column with different properties than the one routinely used. A single peak and the same retention time should be found.

When the nature (identity) of the compound has been determined, quan-

*The column used in this work was an SE-30 constructed of stainless steel, ¼" diameter and 6 ft. in length. The adsorbent was 3.25% SE-30 on 60-70 mesh Anakron ABS.

tity becomes important. These values are determined by using known volumes of standard preparations and determining the areas under the curve, since this value is proportional to the amount of the compound. A bit of caution must be observed at this point, especially where, as in this study, an electron capture detector is used. This type of detector is not equally sensitive to all pesticides and a given amount of lindane, for example, will give a much greater response than an equal amount of DDT. For this reason quantitation determinations must be made separately for each pesticide and in the same solvent used for the sample injection. Ordinarily results of the analysis are reported in parts per million (PPM), however, in the study reported here all results, unless otherwise noted, are presented in parts per billion (PPB) because the concentrations were uniformly low and would have required ungainly decimals.

SECTION VIII
RESULTS - WATER

The findings of this study are presented in detail in Tables I-XIII. It will be seen, if these tables are examined, that the highest values recorded are those found in the Lester River, the Duluth sewage effluent, and the Lower St. Louis River on October 31. The values on that date were 20.0, 20.6, and 21.8 ppb PP'DDT, respectively. These higher than normal concentrations may be ascribed to the runoff resulting from the heavy rains of the previous two weeks. This runoff apparently affected other streams as well as indicated by PP'DDT levels of 9.7 ppb in the Knife River, 7.4 ppb in the Lower Nemadji River, and on the following day 1.8 ppb in the Beaver River. Apparently, the effect of runoff, even when brought about by intermittent showers, produces higher pesticide levels in certain streams. This is demonstrated by the findings on September 9 when such conditions prevailed. The PP' level of DDT in ppb on that date was 11.2 for the Lester River, 3.4 for the Upper St. Louis River, and 3.4 for the Upper Nemadji River.

The above values can be considered to be extremely high when comparisons are made with the majority of the other samples taken in this study since, with the exception of two stations, the median value for PP' was less than 0.01 ppb. The two exceptions were the Upper St. Louis and the Upper Nemadji Rivers where the medians were 0.03 and 0.02 ppb, respectively. In almost every instance, PP'DDT was present in greater concentrations than its OP' isomer or DDE.

SECTION IX
RESULTS - CLAMS

The details relating to field operations and final results obtained in the bioassay studies with clams exposed to surface waters will be found in Tables XIV-XXXXI. Table XIV deals with field operations and sums up the final disposition of all clams which were exposed for experimental purposes during the season. Controls are reported separately in Table XXXIX.

As a supplement to the basic study, 18 native clams collected from the Upper St. Louis River station at various times during the year were analyzed in the same manner as the clams "planted" for the bioassay work. The results from this subsidiary investigation are summarized in Table XXXX. If this and Table XXXXI are consulted it will be seen that native clams exposed for 5 to 12 years in the St. Louis River have acquired appreciable quantities of chlorinated hydrocarbons. For example, one specimen 10 years of age had accumulated PP'DDT in excess of 1600 ppb. The median figure for the whole series was 340 ppb. It is interesting to note that a six-year old clam weighing only 3.5 grams had the highest aldrin concentration of the series, namely 10,670 ppb or 10.67 ppm.

Table XXXXI documents the age, weight, and species of each specimen analyzed. It will be seen that the three species represented in this study were Lampsilis ventricosa, Lampsilis siliquoidea, and Ligumia recta. Ages of these clams ranged from 5 up to 19 years. The older specimens were dark in color and usually very badly eroded; in most instances the entire umbone had been dissolved away. Growth lines were extremely narrow but very distinct and even the oldest shell was surprisingly small. For example, a mature shell of Lampsilis siliquoidea, at least 11 years old, from the St. Louis River, had a total length of only 64 mm and a weight of 13 grams. A dark, heavily eroded, 18-year old Ligumia recta originally from the Deer River area had a total length of 115 mm, a height of 47 mm, and a body weight of 42 grams.

In these days wild clams cannot be expected to be completely free of chlorinated hydrocarbons and thus controls may be expected to include specimens with appreciable levels of DDE and the isomers of DDT. The controls used in this study were no exception even though they came from a sparsely settled area near Deer River. In terms of the PP' isomer of DDT, which was the chlorinated hydrocarbon in highest concentration, it was found that three specimens of the 51 tested exceeded 1 ppm. Statistical consultants indicated that such extremely high values would make the use of means unreliable and suggested than only medians should be employed for the evaluation of the data. On this basis, the control values arrived at were as follows: OP'DDT, 20 ppb; PP'DDT, 17 ppb; DDE, $<$10 ppb (the latter, for practical purposes, is 1 ppb).

Preceding page blank

The details relating to the specific chlorinated hydrocarbon content for any given individual test specimen or control clam may be found in Tables XV to XXXXI. A summation of the median values, including the control references, is found in Table XXXXII. If the summary table is examined, it will be seen that in only four instances are the median values exceeded. Thus, for PP', there was an increase in the body burden of exposed clams in three streams only, the Brule, Beaver, and Upper St. Louis. In the St. Louis and Beaver the median values were 41 ppb and 32 ppb, respectively, as contrasted with 20 ppb for the controls. This is in keeping with observations that chlorinated hydrocarbon values have reached levels as high as 21.3 ppb in the St. Louis and 1.3 ppb in the Beaver River after a series of rains. The high value of 131 ppb in clams from the Brule cannot be accounted for at this time. If the OP' isomer is considered it will be seen that the median of 17 ppb in the controls is exceeded only in Beaver River clams which had a value of 28 ppb. This difference may not be significant. All DDE values were less than the median for controls.

The subsidiary studies carried out on "native clams", that is on naturally occurring clams collected from the stream being studied, revealed that the St. Louis River must be carrying a load of chlorinated hydrocarbons either on an intermittent high level basis or at a low constant level. This conclusion is based on the observation that these clams were very much higher in their body burdens than the control groups. Also, there could be no doubt that they had obtained their pesticides from that river since they had matured there. Analysis for PP'DDT showed that the median was 340 ppb as contrasted with the 20 ppb concentration in controls. When OP' was checked the median was 67 ppb compared to 17 ppb for the controls. Finally, the median for DDE was 15 ppb whereas the control level was <10 ppb. It should also be pointed out that the range of values for PP' was 93 ppb to 1630 ppb. However, no value was as low as the <0.01 ppb level so commonly found in the controls. The age of these clams ranged from 5 to 11 years. The 5-year old clam which had a 93 ppb PP' level weighed only 3 grams. The 11-year old specimen had 240 ppb of the PP' isomer. The highest value recorded, namely 1630 ppb was reached in a 10-year old clam weighing 18 grams. All native clams taken in the St. Louis River were Lampsilis siliquoidea.

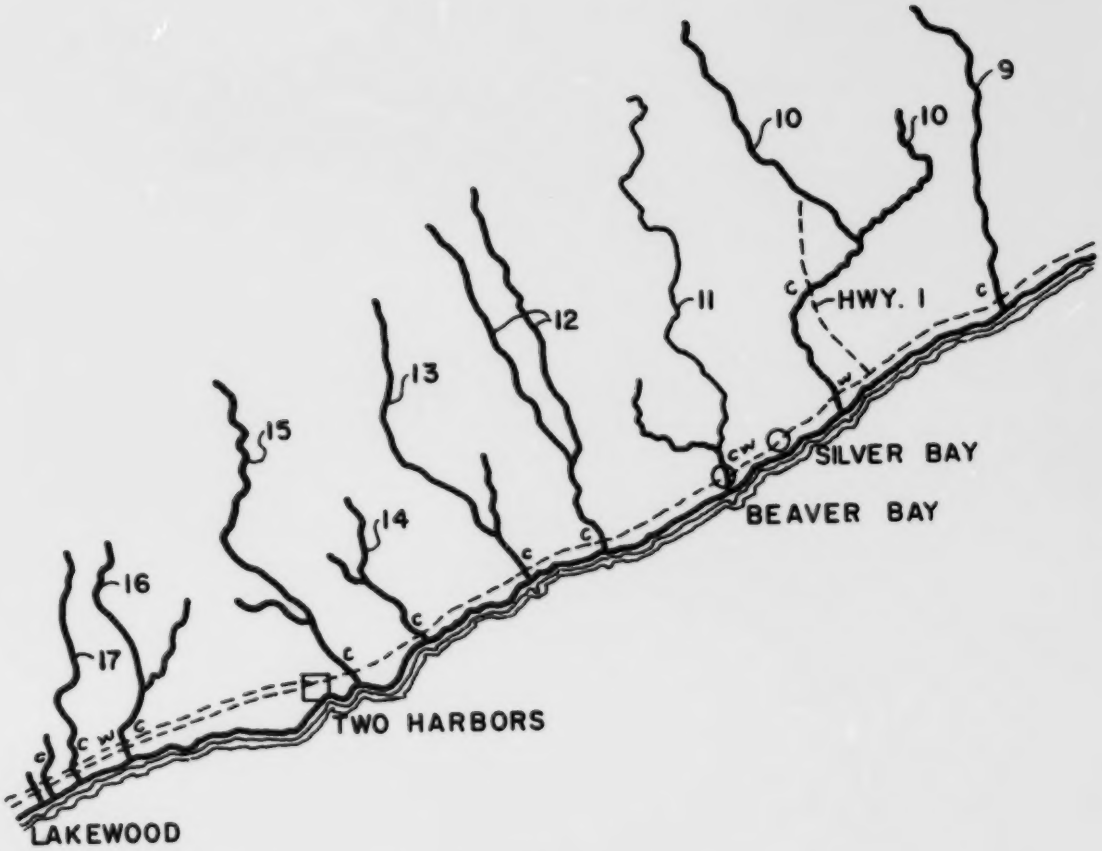
SECTION X
ACKNOWLEDGEMENTS

The contributions made by Dr. Theron O. Odlaug and Dr. Theodore A. Olson of the University of Minnesota, in directing and carrying out the field studies and in the preparation of the final report of this study is hereby gratefully acknowledged. Thanks are also extended to Mr. Russell Frazier, Director of Laboratories and especially Mr. Vernon Tarman, analyst for the State Health Department, for their competent professional services in making pesticide analyses of the many water samples and the large number of clam samples delivered to them.

The assistance of Dr. Blanchard Krogstad and Mr. Daniel Engstrom, who assisted the senior investigators in the implementation of the field study is sincerely appreciated. Mr. Engstrom deserves special commendations for his performance in the role of sample collector and for the high level of responsibility shown by him in the maintenance of accurate and detailed scientific records.

PESTICIDE STUDIES
NORTH SHORE
FIG. 1

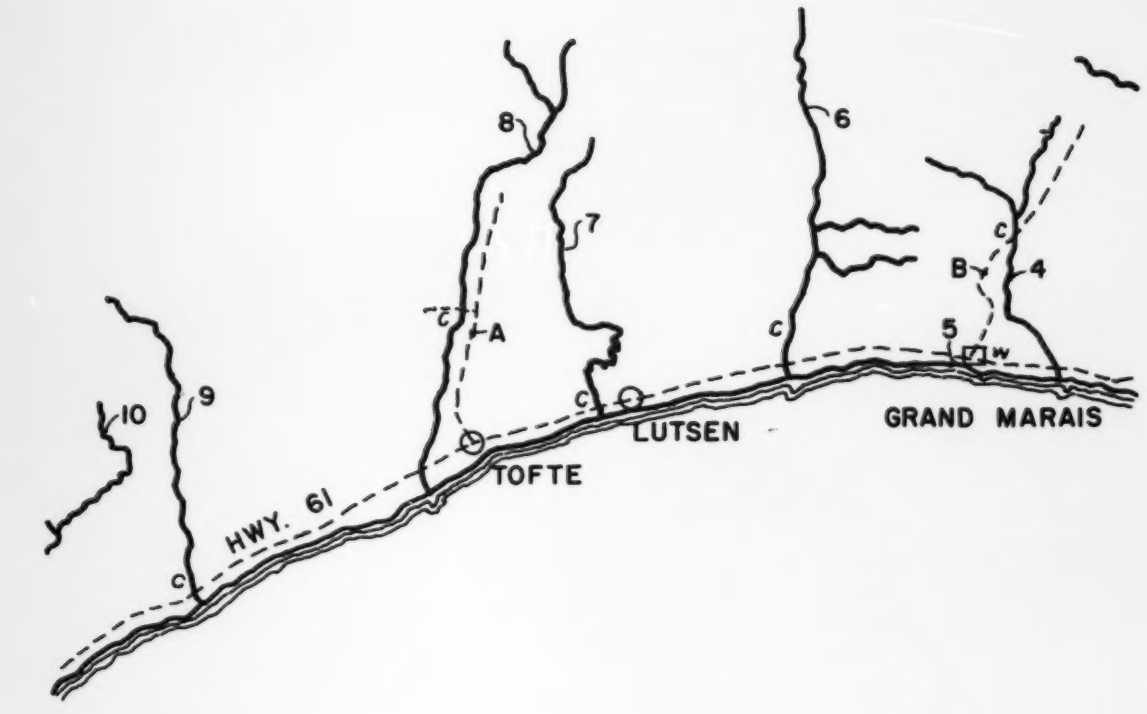
Preceding page blank



C.... CLAM STATION
W.... WATER STATION

Preceding page blank

FIG. 2



A...SAWBILL TRAIL
B...GUNFLINT TRAIL

SCALE: ONE INCH EQUALS 8 MILES

Preceding page blank FIG. 3

1. PIGEON RIVER
2. RESERVATION RIVER
3. BRULE RIVER (ARROWHEAD)
4. DEVIL TRACK RIVER
5. GRAND MARAIS PUMPING STATION
6. CASCADE RIVER
7. POPLAR RIVER
8. TEMPERANCE RIVER
9. MANITOU RIVER
10. BAPTISM RIVER
11. BEAVER RIVER
12. SPLIT ROCK RIVER
13. GOOSEBERRY RIVER
14. ENCAMPMENT RIVER
15. STEWART RIVER
16. KNIFE RIVER
17. BIG SUCKER RIVER
18. SCHMIDT CREEK
19. FRENCH RIVER
20. TALMADGE RIVER
21. DULUTH PUMPING STATION
22. LESTER RIVER
23. UPPER ST. LOUIS RIVER
24. LOWER ST. LOUIS RIVER
25. DULUTH SEWAGE TREATMENT PLANT
26. UPPER NEMADJI RIVER
27. LOWER NEMADJI RIVER

Preceding page blank

FIG. 4

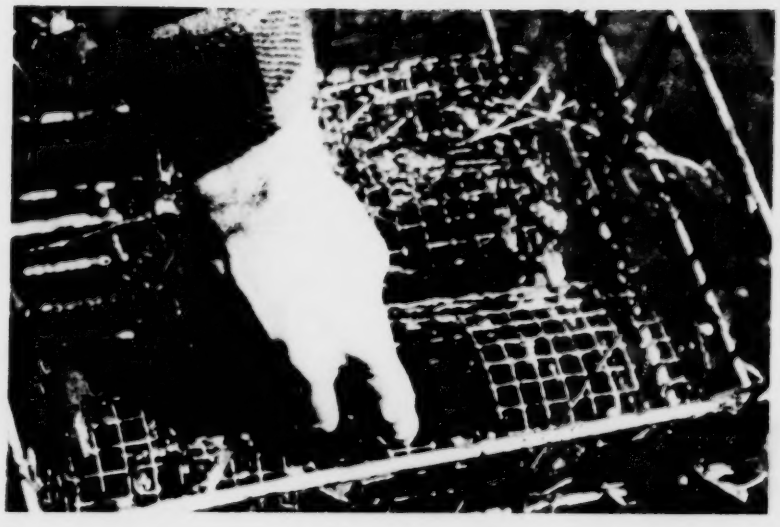


Figure 5 - Type of basket used in bioassay studies

Reproduced from best available copy.

Figure 6 - North Shore streams - the Temperance River

Preceding page blank

Figure 7 - North Shore streams - the Cascade River

Reproduced from best available copy.

Figure 8 - North Shore streams - the Split Rock River

Preceding page blank

TABLE I

RIVER: PIGEON WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter ppm	Turbidity	DDT(OP')	DDT(PP')	DDE
1	5-9	high, over banks	turbulent	---	11	1	7.6	< .05 ppb	< .05 ppb	< .05 ppb
	6-12	down 3"	turbulent	16	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 12"	fast	23	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	same	fast	21	6	2	5.1	< .01 ppb	< .01 ppb	< .01 ppb
	9-8	same	fast	19	7	3	6.7	< .01 ppb	< .01 ppb	< .01 ppb
	10-4	up 1"	fast	7	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-1	up 16"	turbulent	6	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb

Preceding page blank

TABLE II

RIVER: ARROWHEAD (BRULE) WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
3	5-9	high, over banks	turbulent	---	2	: .5	2	< .05 ppb	< .05 ppb	< .05 ppb
	6-12	down to within banks	turbulent	16	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 9"	turbulent	24	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	down 3"	fast	20	2	2	1.6	< .01 ppb	< .01 ppb	< .01 ppb
	9-8	down 1"	fast	17	6	3	2.5	< .01 ppb	< .01 ppb	< .01 ppb
	10-4	up 2"	fast	6	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-1	up 22"	turbulent	6	---	---	---	1.6 ppb	< .01 ppb	-----
	11-22	down 6"	turbulent	0	10	2	1.8	< .01 ppb	< .01 ppb	< .01 ppb
	12-6	-----	-----	0	2	.8	2	< .01 ppb	0.13 ppb	< .01 ppb

TABLE III

RIVER: BAPTISM WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
10	5-9	high, over banks	turbulent	---	5	2	2.8	< .05 ppb	< .05 ppb	< .05 ppb
	6-12	down slight	turbulent	---	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 12"	moderate	23	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	down 2"	moderate	22	< .5	< .5	0.8	< .01 ppb	< .01 ppb	< .01 ppb
	9-8	same	moderate	17	< .5	< .5	1.2	< .01 ppb	< .01 ppb	< .01 ppb
	10-4	up 3"	moderate	6	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-1	up 28"	turbulent	5	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-22	down 10"	fast	0	8	1	1.3	< .01 ppb	< .01 ppb	< .01 ppb
	12-6	-----	turbulent	0	0.8	0.8	1.8	< .01 ppb	0.03 ppb	< .01 ppb

TABLE IV

GRAND MARAIS (PUMPING STA) WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
5	5-23				2	2	1.3	< .01 ppb	< .01 ppb	< .01 ppb
	6-12				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7				< .5	< .5	1.7	< .01 ppb	< .01 ppb	< .01 ppb
	9-8				< .5	< .5	0.9	< .01 ppb	< .01 ppb	< .01 ppb
	10-4				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-1				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-22				13	2	1.7	< .01 ppb	< .01 ppb	< .01 ppb
	12-6				0.8	0.8	0.7	< .01 ppb	.03 ppb	< .01 ppb

TABLE 1

RIVER: BEAVER WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
11	5-9	high	fast	---	16	2	17	< .05 ppb	< .05 ppb	< .05 ppb
	6-12	down 6"	moderate	14	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 8"	moderate	24	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	down 2"	slow-mod.	23	3	2	6.5	< .01 ppb	< .01 ppb	< .01 ppb
	9-8	same	slow	20	14	2	28	< .01 ppb	< .01 ppb	< .01 ppb
	10-4	up 1"	slow	9	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-1	up 26"	turbulent	5	---	---	---	0.4 ppb	1.8 ppb	-----
	11-22	down 12"	mod.-fast	0	15	2	16	< .01 ppb	< .01 ppb	< .01 ppb
	12-6	-----	-----	0	4	2	9.2	< .01 ppb	0.05 ppb	< .01 ppb

TABLE VI

RIVER: KNIFE WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
16	5-9	high, over banks	fast	---	24	3	64	< .05 ppb	< .05 ppb	< .05 ppb
	6-12	down 12"	fast	14	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 29"	sluggish	27	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	down 2"	slow	22	0.8	0.8	2.	< .01 ppb	< .01 ppb	< .01 ppb
	9-8	up 12"	slow	20	4	1	4.4	< .01 ppb	< .01 ppb	< .01 ppb
	10-3	same	slow	11	---	---	---	-----	-----	-----
	10-31	up 40"	turbulent	6	---	---	---	< .01 ppb	9.7 ppb	-----
	11-21	down 30"	mod.-fast	1	9	1	43	< .01 ppb	< .01 ppb	< .01 ppb
	12-11	-----	-----	0	2	1	35	< .01 ppb	0.02 ppb	< .01 ppb

TABLE VII

LAKEWOOD, DULUTH (PUMPING STATION) WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
21	5-26				< .5	< .5	1.9	< .01 ppb	< .01 ppb	< .01 ppb
	6-12				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7				< .5	< .5	4.5	< .01 ppb	< .01 ppb	< .01 ppb
	9-9				< .5	< .5	0.8	.65 ppb	2.40 ppb	-----
	10-5				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	11-4				---	---	---	-----	-----	-----
	11-27				12	3	1.2	< .01 ppb	< .01 ppb	< .01 ppb
	12-11				0.8	0.8	1.2	< .01 ppb	< .01 ppb	< .01 ppb

TABLE VIII

RIVER: LESTER

WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
22	5-26	high	turbulent	---	2	2	4.9	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb
	6-12	down 6"	fast	---	---	---	---	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb
	7-10	down 18"	sluggish	24	---	---	---	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb
	8-7	down 2"	sluggish	23	1	1	1.4	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb
23	9-9	down 2"	sluggish	19	≤ .5	≤ .5	1.1	2.3 ppb	11.2 ppb	-----
	10-3	same	moderate	8	---	---	---	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb
	10-31	up 15"	turbulent	6	---	---	---	≤ .01 ppb	20.0 ppb	-----
	11-21	down 8"	turbulent	1	≤ .5	≤ .5	5.4	-----	.022 ppb	(≤ .01 ppb Aldrin)
	12-11	-----	-----	0	≤ .5	≤ .5	3.3	≤ .01 ppb	≤ .01 ppb	≤ .01 ppb

TABLE IX

RIVER: UPPER ST. LOUIS WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
23	5-8	high	fast	---	48	5	14	-: .05 ppb	-: .05 ppb	-: .05 ppb
	5-26	down 12"	moderate	---	14	3	4.9	-: .01 ppb	-: .01 ppb	-: .01 ppb
	7-10	down 42"	sluggish	24	---	---	---	-: .01 ppb	-: .01 ppb	-: .01 ppb
	8-7	same	sluggish	24	3	2	2.7	-: .01 ppb	-: .01 ppb	-: .01 ppb
	9-9	same	sluggish	20	9	3	4.4	0.85 ppb	3.40 ppb	-----
	10-3	down 2"	sluggish	11	---	---	---	-: .01 ppb	-: .01 ppb	-: .01 ppb
	10-31	up 18"	slow	6	---	---	---	-: .01 ppb	0.1 ppb	---
	11-21	down 2"	slow	1	2	2	3.6	-----	.079 ppb	(-: .01 ppb Aldrin)
	12-11	-----	-----	0	9	3	2.8	-: .01 ppb	0.03 ppb	-: .01 ppb

TABLE X

RIVER: LOWER ST. LOUIS WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
24	6-14	-----	slow	---	-----	-----	-----	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 2"	sluggish	23	-----	-----	-----	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	same	very sluggish	24	2	2	3.5	< .01 ppb	< .01 ppb	< .01 ppb
	9-9	down 1"	very sluggish	20	12	6	7.0	1.00 ppb	1.20 ppb	-----
	10-3	down 3"	very slug.	10	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	10-31	up 4"	very slug.	8	---	---	---	< .01 ppb	21.8 ppb	-----
	11-21	down 2"	very slug.	1	6	2	7.3	< .01 ppb	< .01 ppb	< .01 ppb
	12-11	-----	-----	0	4	2	2.2	< .01 ppb	0.03 ppb	< .01 ppb

TABLE XI

DULUTH SEWAGE PLANT WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
27	8-7				56	41	57	< .01 ppb	< .01 ppb	< .01 ppb
	9-9				36	30	33	< .01 ppb	< .01 ppb	< .01 ppb
	10-3				---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	10-31				---	---	---	4.7 ppb	20.6 ppb	-----
	11-21				34	20	22	-----	.02 ppb	-----
	12-11				22	15	11	< .01 ppb	< .01 ppb	< .01 ppb

TABLE XII

RIVER: UPPER NEMADJI WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
25	5-8	high, over banks	moderate	---	86	8	45	< .05 ppb	< .05 ppb	< .05 ppb
	5-26	down 60"	slow	10	78	10	95	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 40"	slow	23	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	up 2"	slow	24	30	4	26	< .01 ppb	< .01 ppb	< .01 ppb
	9-9	down 1"	slow	20	20	2	15	1.15 ppb	3.40 ppb	-----
	10-3	same	slow	9	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	10-31	up 24"	moderate	6	---	---	---	< .01 ppb	1.4 ppb	-----
	11-21	same	moderate	2.	21	4	27	-----	-----	(.024 ppb Aldrin)
	12-11	-----	-----	0	5	2	13	< .01 ppb	0.02 ppb	< .01 ppb

TABLE XIII

RIVER: LOWER NEMADJI WATER ANALYSIS

River Number	Date of Sample	Field Data			Analytical Data					
		Water Level	Flowage	Temp. (C°)	Suspended Solids ppm	Suspended Volatile Matter	Turbidity	DDT(OP')	DDT(PP')	DDE
26	6-14	within banks	sluggish	---	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	7-10	down 6"	sluggish	24	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	8-7	up 5"	sluggish	24	22	4	26	< .01 ppb	< .01 ppb	< .01 ppb
	9-9	up 1"	sluggish	21	10	2	11	0.06 ppb	< .01 ppb	-----
	10-3	down 5"	sluggish	10	---	---	---	< .01 ppb	< .01 ppb	< .01 ppb
	10-31	up 5"	sluggish	7	---	---	---	< .01 ppb	7.4 ppb	-----
	11-21	down 1"	sluggish	2	15	2	23	-----	.053 ppb	(.048 ppb Aldrin)
	12-11	-----	-----	0	7	2	16	< .01 ppb	.02 ppb	< .01 ppb

TABLE XIV

SUMMARY OF FIELD OPERATIONS - CLAMS

River	Number of Clams "Planted"	Date	Disposition of Clams		
			Collected for Analysis	Destroyed or Lost	Died
Pigeon	4	May 9	4		
	5	May 23	3		2
	15	June 17	14	1	
Reservation	5	May 23	3		2
	15	June 17	12		3
Arrowhead	15	June 17	15		
Devil Track	5	May 23		5	
	15	June 17	10	4	1
Cascade	5	May 23	3		2
	15	June 17	15		
Poplar	5	May 23	1	1	3
	15	June 17	9	4	2
Temperance	5	May 24		4	1
	15	June 17	11	4	
Manitou	5	May 24	4		1
	15	June 17		15	
	30	June 30	19	9	2
Baptism	4	May 9	2	2	
	5	May 24		5	
	15	June 17	11	3	1
Beaver	4	May 9	3		1
	5	May 24	5		
	15	June 17	13	1	1
Split Rock	5	May 24	1	4	
	15	June 17	12	3	
Gooseberry	15	June 15	11	3	1
Encampment	15	June 15	12	3	
Stewart	5	May 24	1	4	
	15	June 15	9	4	2
Knife	4	May 9	2	2	
	5	May 24	4		1
	15	June 14	7	7	1
	7	June 22	6		1

TABLE XIV

SUMMARY OF FIELD OPERATIONS - CLAMS

River	Number of Clams "Planted"	Date	Disposition of Clams		
			Collected for Analysis	Destroyed or Lost	Died
Big Sucker	5	May 24			1
	15	June 14	15 mixed with May 24 clams		
	19 mixture		13	3	3
	15	June 22	11		4
Schmidt Cr.	5	May 24	4		1
	15	June 15	15		
French	5	May 24		5	
	15	June 15	14		1
Talmadge	5	May 24	1	2	2
	15	June 15	11	1	3
Lester	5	May 26	5 mixed with June 14 clams		
	15	June 14	6	9 mixed with May 26 clams	
	14 mixture		10	4	
Upper St. Louis	5	May 26	4		1
	15	June 14	12		3
Lower St. Louis	15	June 14	12	3	
Upper Nemadji	5	May 26	4		1
	15	June 14	11	4	
Lower Nemadji	15	June 16	15		

TABLE XV

RIVER PIGEON

CLAM SAMPLE - SITE DESCRIPTION:

LOCATION: 200 yds downstream from old port of entry on U.S. side.

BOTTOM: large rocks, gravel and pieces of slate.

TERRAIN: steep banks to river in most places, some bluffs.

FLOW: fast to occasionally turbulent.

VEGETATION: Alnus rugosa, Cornus stolonifera, Picea glauca, Pinus resinosa, Abies balsamea.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c1-5-9-70	4	May 9						
c1-5-23-70-1	5	May 23	from c1-5-9-70	May 23	< .01 ppb	< .01 ppb	< .01 ppb	
c1-5-23-70-2			from c1-5-9-70	May 23	< .01 ppb	< .01 ppb	< .01 ppb	
c1-6-17-70	15	June 17						
c1-6-30-70			from c1-6-17-70	June 30	49.5 ppb	170 ppb	1.7 ppb	
c1-7-14-70			from c1-6-17-70	July 14	1.20 ppm	6.10 ppm	19 ppb	
c1-7-27-70			from c1-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c1-8-11-70			from c1-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c1-8-25-70			from c1-6-17-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c1-9-8-70			from c1-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c1-9-22-70			from c1-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c1-10-4-70			from c1-6-17-70	Oct. 4	77.0 ppb	74.0 ppb	35.0 ppb	
c1-10-18-70-d1			from c1-5-9-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	

TABLE XV

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER PIGEON (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c1-10-18-70-d2			from c1-5-9-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d3			from c1-5-23-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d4			from c1-5-23-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d5			from c1-5-23-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d6			from c1-6-17-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d7			from c1-6-17-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d8			from c1-6-17-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d9			from c1-6-17-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d10			from c1-6-17-70	Oct. 18	< .1 ppb **	< .1 ppb	< .1 ppb	
c1-10-18-70-d11			from c1-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	

c=clam sample
1=no. of river
10=month
18=day
70=year
d=clam dead when collected
11=specific clam no. if more than one collected at same time

** composite of samples c1-10-18-70-d1 thru d11 inc.

TABLE XVI

CLAM SAMPLE - RIVER RESERVATION

SITE DESCRIPTION:

LOCATION: 200 ft. upstream from bridge on highway #61.

BOTTOM: large boulders, gravel and sand in pools where current slower.

FLOW: moderate to fast current, occasionally turbulent.

TERRAIN: banks rather level, eroded in a few locations.

VEGETATION: Alnus rugosa, Corylus cornuta, Cornus stolonifera, Betula papyrifera, and a few Abies balsamea.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c2-5-23-70	5	May 23						
c2-6-17-70	15	June 17						
c2-6-30-70			From c2-6-17-70	June 30	< .1 ppb	162 ppb	0.6 ppb	
c2-7-14-70			From c2-6-17-70	July 14	94 ppb	611 ppb	< .1 ppb	
c2-7-27-70			From c2-6-17-70	July 27	655 ppb	< .1 ppb	< .1 ppb	
c2-8-11-70			From c2-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c2-8-25-70			From c2-6-17-70	Aug. 25	700 ppb	3.72 ppm	85 ppb	
c2-9-8-70			From c2-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c2-9-22-70			From c2-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c2-10-4-70			From c2-6-17-70	Oct. 4	< .1 ppb	134 ppb	< .1 ppb	
c2-10-18-70			From c2-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	
c2-11-1-70			From c2-6-17-70	Nov. 1	< .1 ppb	< .1 ppb	< .1 ppb	
c2-11-8-70			From c2-6-17-70	Nov. 8	39.0 ppb	106 ppb	18.0 ppb	

TABLE XVI

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER [illegible] (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c2-11-22-70			from c2-6-17-70	Nov. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c2-12-6-70-1			from c2-6-13-70	Dec. 6	---------	---------	---------	
c2-12-6-70-2			from c2-6-13-70	Dec. 6	< .1 ppb **	< .1 ppb	< .1 ppb	
c2-12-6-70-3			from c2-6-13-70	Dec. 6	< .1 ppb **	< .1 ppb	< .1 ppb	

c=clam sample
2=no. of river
12 month
6=day
70=year
3=specific clam no. if more than one collected at each time

dashed line indicates no analysis made

** composite of samples c2-12-6-70-2 and -3

TABLE XVII

CLAM SAMPLE - RIVER ARROWHEAD (BRULE)

SITE DESCRIPTION:

LOCATION: 200 ft. upstream from bridge on highway 61.

BOTTOM: large boulders and rocks.

FLOW: fast to turbulent

TERRAIN: very steep banks and high bluffs except in short stretch below bridge

VEGETATION: Cornus stolonifera, Alnus rugosa, Rubus strigosus, Ribes sp., Betula papyrifera, Picea glauca, Abies balsamea.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c3-6-17-70	15	June 17						
c3-6-30-70			from c3-6-17-70	June 30	< .1 ppb	131 ppb	< .1 ppb	
c3-7-14-70			from c3-6-17-70	July 14	635 ppb	3.5 ppm	< .1 ppb	
c3-7-27-70			from c3-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c3-8-11-70			from c3-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c3-8-25-70			from c3-6-17-70	Aug. 25	49 ppb	147 ppb	< .1 ppb	
c3-9-8-70			from c3-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c3-9-22-70			from c3-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c3-10-4-70			from c3-6-17-70	Oct. 4	110 ppb	310 ppb	57.0 ppb	
c3-10-18-70			from c3-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	
c3-11-8-70			from c3-6-17-70	Nov. 8	< .1 ppb	256 ppb	< .1 ppb	
c3-11-22-70			from c3-6-17-70	Nov. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c3-12-6-70-			from c3-6-17-70	Dec. 6	---------	---------	-----	

TABLE XVII

CLAM SAMPLE - RIVER ARROWHEAD (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c3-12-6-70-1			from c3-6-17-70	Dec. 6	176 ppb **	285 ppb	72 ppb	
c3-12-6-70-3			from c3-6-17-70	Dec. 6	176 ppb **	285 ppb	72 ppb	
c3-12-6-70-4			from c3-6-17-70	Dec. 6	---------	---------	------	

c=clam sample
3=no. of river
12=month
6=day
70=year
4=specific clam no. if [illegible] collected at a station

dashed line indicates no analysis made

** composite of samples c3-12-6-70-2 and -3

TABLE XVIII

CLAM SAMPLE - RIVER DEVIL TRACK

SITE DESCRIPTION:

LOCATION: 400 ft. upstream from bridge on Gunflint Trail, just above entry of Elbow Creek.

BOTTOM: mostly broken pieces of slate, a few boulders.

FLOW: usually fast, occasionally turbulent, during dry weather...moderate.

TERRAIN: flat with low banks.

VEGETATION: Alnus rugosa, Rubus strigosus, Betula papyrifera, Prunus pennsylvanica, Abies balsamea.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
64-6-23-70	5	May 23						
64-6-17-70	15	June 17						
64-6-30-70			From 64-6-17-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
64-7-14-70			From 64-6-17-70	July 14	240 ppb	1.27 ppm	< .1 ppb	
64-7-27-70			From 64-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
64-8-11-70			From 64-6-17-70	Aug. 11	75 ppb	< .1 ppb	8.0 ppb	
64-8-25-70			From 64-6-17-70	Aug. 25	15 ppb	63 ppb	< .1 ppb	
64-9-8-70			From 64-6-17-70	Sept.	< .1 ppb	< .1 ppb	< .1 ppb	
64-9-22-70			From 64-6-17-70	Sept.	< .1 ppb	< .1 ppb	< .1 ppb	
64-10-4-70			From 64-6-17-70	Oct. 4	156 ppb	< .1 ppb	62 ppb	
64-10-18-70			From 64-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	
64-11-8-70			From 64-6-17-70	Nov. 8	35.0 ppb	131 ppb	38.0 ppb	

TABLE XIX

CLAM SAMPLE - RIVER CASCADE

SITE DESCRIPTION:

LOCATION: apx. one half mile upstream from bridge on highway #61.

BOTTOM: large boulders and slate outcrop.

FLOW: moderate to fast, occasionally turbulent.

TERRAIN: steep banks and high bluffs, river is a series of cascades and small waterfalls.

VEGETATION: Cornus stolonifera, Alnus rugosa, Betula papyrifera, Picea glauca, Abies balsamea, Pinus Strobus, Pinus resinosa.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
e6-5-23-70	5	May 23						
e6-6-17-70	15	June 17						
e6-6-30-70			from e6-6-17-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
e6-7-14-70			from e6-6-17-70	July 14	< .1 ppb	1.39 ppm	< .1 ppb	
e6-7-27-70			from e6-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
e6-8-11-70			from e6-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
e6-8-25-70			from e6-6-17-70	Aug. 25	10 ppb	52 ppb	3 ppb	
e6-9-8-70			from e6-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
e6-9-22-70			from e6-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
e6-10-4-70			from e6-6-17-70	Oct. 4	333 ppb	567 ppb	24 ppb	
e6-10-18-70			from e6-6-17-70	Oct. 18	40 ppb	139 ppb	< .1 ppb	
e6-11-1-70			from e6-6-17-70	Nov. 1	12.0 ppb	348 ppb	30.0 ppb	
e6-11-8-70			from e6-6-17-70	Nov. 8	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XIX

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER CASCADE (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c6-11-2[illegible]-70			from c6-6-17-70	Nov. 2[illegible]	< .1 ppb	< .1 ppb	< .1 ppb	
c6-12-6-70-1			from c6-6-3-70	Dec. 6	< .1 ppb **	< .1 ppb	< .1 ppb	
c6-12-6-70-2			from c6-6-3-70	Dec. 6	---------	---------	------	
c6-12-6-70-3			from c6-6-3-70	Dec. 6	---------	---------	------	
c6-12-6-70-4			from c6-6-17-70	Dec. 6	< .1 ppb **	< .1 ppb	< .1 ppb	
c6-12-6-70-5			from c6-6-17-70	Dec. 6	---------	---------	------	
c6-12-6-70-6			from c6-6-17-70	Dec. 6	< .1 ppb **	< .1 ppb	< .1 ppb	

c=clam sample
6=no. of river
12=month
6=day
70=year
1=specific clam no. (if more than 1 clam collected at one time)

dashed line indicates no analysis made

** composite of samples c6-12-6-70-1, -4 and -6

TABLE XX

CLAM SAMPLE - RIVER POPLAR

SITE DESCRIPTION:

LOCATION: 200 yds upstream from bridge on highway #61.

BOTTOM: large boulders and basaltic lava flows.

FLOW: usually very turbulent.

TERRAIN: steep banks and high bluffs, river is a series of rapids and falls.

VEGETATION: Cornus stolonifera, Betula papyrifera, Abies balsamea, Picea glauca.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c7-5-23-70	5	May 23						
c7-6-17-70	15	June 17						
c7-6-30-70			from c7-6-17-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
c7-7-14-70			from c7-6-17-70	July 14	644 ppb	2.17 ppm	11 ppb	
c7-7-27-70			from c7-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c7-8-11-70			from c7-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c7-8-25-70			from c7-6-17-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c7-9-8-70			from c7-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c7-9-22-70			from c7-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c7-10-4-70			from c7-6-17-70	Oct. 4	37.0 ppb	115 ppb	< .1 ppb	
c7-10-18-70			from c7-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	
c7-10-18-70-d			from c7-5-23-70	Oct. 18	-------	--------	-----	

dashed line indicates no analysis made

TABLE XXI

CLAM SAMPLE - RIVER TEMPRANCE

SITE DESCRIPTION:

LOCATION: 100 yds downstream from Sixmile Bridge just off Sawbill Trail.

BOTTOM: boulders, large rocks, gravel and some sand in few locations where current slows.

FLOW: usually fast to turbulent.

TERRAIN: rather level in this area of stream with gradual banks, river is a continuous series of rapids.

VEGETATION: Alnus rugosa, Prunus virginiana, Viburnum trilobum, Fraxinus nigra, Populus balsamifera, Picea glauca.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c8-6-24-70	5	June 24						
c8-6-17-70	15	June 17						
c8-6-30-70			from c8-6-17-70	June 30	17 ppb	258 ppb	< .1 ppb	
c8-7-14-70			from c8-6-17-70	July 14	35 ppb	1.32 ppm	< .1 ppb	
c8-7-27-70			from c8-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c8-8-11-70			from c8-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c8-8-25-70			from c8-6-17-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c8-9-8-70			from c8-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c8-9-22-70			from c8-6-17-70	Sept. 22	74.0 ppb	< .1 ppb	19.0 ppb	
c8-10-4-70			from c8-6-17-70	Oct. 4	128 ppb	70.0 ppb	60.0 ppb	
c8-10-18-70			from c8-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	
c8-11-1-70			from c8-6-17-70	Nov. 1	< .1 ppb	233 ppb	65 ppb	
c8-11-8-70			from c8-6-17-70	Nov. 8	27 ppb	94 ppb	40 ppb	

TABLE XXII

CLAM SAMPLE - RIVER MANITOU

SITE DESCRIPTION:

LOCATION: 400 ft. upstream from bridge on highway #61.

FLOW: slow to moderate current except when water was high.

TERRAIN: banks of river consist of steep, high bluffs or cliffs, forms narrow gorges, river is a series of falls and deep channels.

VEGETATION: Thuja occidentalis, Abies balsamea, Pinus strobus.

BOTTOM: large boulders in rapids and gravel and rocks in deep channels.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c9-5-24-70	5	May 24						
c9-6-17-70	15	June 17						
c9-6-30-70	30	June 30	from c9-5-24-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
c9-7-14-70			from c9-6-30-70	July 14	< .1 ppb	< .1 ppb	< .1 ppb	
c9-7-27-70			from c9-6-30-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c9-8-11-70			from c9-6-30-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c9-8-25-70			from c9-6-30-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c9-9-8-70			from c9-6-30-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c9-9-22-70			from c9-6-30-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c9-10-4-70			from c9-6-30-70	Oct. 4	-------	-------	-----	
c9-11-8-70			from c9-6-30-70	Nov. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c9-12-6-70-1			from c9-5-24-70	Dec. 6	-------	-------	-----	
c9-12-6-70-2			from c9-5-24-70	Dec. 6	-------	-------	-----	

TABLE XXII

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER MANITOU (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c9-12-6-70-3			from c9-5-24-70	Dec. 6	51 ppb **	71 ppb	27 ppb	
c9-12-6-70-4			from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-5			from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-6			from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-7			from c9-6-30-70	Dec. 6	51 ppb **	71 ppb	27 ppb	
c9-12-6-70-8			from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-9			from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-10			from c9-6-30-70	Dec. 6	51 ppb **	71 ppb	27 ppb	
c9-12-6-70-	11		from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-	12		from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-	13		from c9-6-30-70	Dec. 6	-------	-------	-----	
c9-12-6-70-	14		from c9-6-30-70	Dec. 6	51 ppb **	71 ppb	27 ppb	

dashed line indicates no analysis made
** composite of samples c9-12-6-70-3, -7, -10 and -14

TABLE XXIII

CLAM SAMPLE - RIVER BAPTISM

SITE DESCRIPTION:

LOCATION: 200 ft. downstream from bridge on state highway #1.

BOTTOM: boulders, large rocks and some gravel.

FLOW: usually fast, occasionally turbulent.

TERRAIN: level with gradually sloping banks.

VEGETATION: Alnus rugosa, Corylus cornuta, Cornus stolonifera.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c10-5-9-70	4	May 9						
c10-5-24-70-1	5	May 24	from c10-5-9-70	May 24	1.35 ppb	4.50 ppb	< .2 ppb	
c10-5-24-70-2			from c10-5-9-70	May 24	1.35 ppb	4.50 ppb	< .2 ppb	
c10-6-17-70	15	June 17						
c10-6-30-70			from c10-6-17-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
c10-7-14-70			from c10-6-17-70	July 14	600 ppb	3.08 ppm	< .1 ppb	
c10-7-27-70			from c10-6-17-70	July 27	< .1 ppb	< .1 ppb	< .1 ppb	
c10-8-11-70			from c10-6-17-70	Aug. 11	< .1 ppb	< .1 ppb	< .1 ppb	
c10-8-25-70			from c10-6-17-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c10-9-8-70			from c10-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c10-9-22-70			from c10-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	
c10-10-4-70			from c10-6-17-70	Oct. 4	72 ppb	195 ppb	< .1 ppb	
c10-10-18-70			from c10-6-17-70	Oct. 18	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXIII

CLAM SAMPLE - RIVER BAPTISM (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c10-11-8-70			from c10-6-17-70	Nov. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c10-11-22-70			from c10-6-17-70	Nov. 22	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXIV

CLAM SAMPLE - RIVER BEAVER

SITE DESCRIPTION:

LOCATION: down steep bank adjacent to spur road off state highway #4.

BOTTOM: large boulders and basaltic lava flows.

FLOW: usually slow to moderate, occasionally fast.

TERRAIN: steep banks and rather rugged relief, river is a series of small waterfalls and pools.

VEGETATION: Corylus cornuta, Alnus rugosa, Thuja occidentalis, Picea glauca, Pinus strobus, Fraxin nigra.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c11-5-9-70	4	May 9						
c11-5-24-70-1	5	May 24	from c11-5-9-70	May 24	93.2 ppb	< .2 ppb	< .2 ppb	
c11-5-24-70-2			from c11-5-9-70	May 24	93.2 ppb	< .2 ppb	< .2 ppb	
c11-6-17-70	15	June 17						
c11-6-30-70			from c11-6-17-70	June 30	32 ppb	640 ppb	< .1 ppb	
c11-7-14-70			from c11-6-17-70	July 14	< .1 ppb	< .1 ppb	< .1 ppb	
c11-7-27-70			from c11-6-17-70	July 27	106 ppb	145 ppb	83 ppb	
c11-8-11-70			from c11-6-17-70	Aug. 11	108 ppb	209 ppb	9 ppb	
c11-8-25-70			from c11-6-17-70	Aug. 25	23 ppb	102 ppb	< .1 ppb	
c11-9-8-70			from c11-6-17-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c11-9-22-70			from c11-6-17-70	Sept. 22	16 ppb	72 ppb	3.0 ppb	
c11-10-4-70			from c11-6-17-70	Oct. 4	83 ppb	276 ppb	10 ppb	Hg .07 ppb
c11-10-18-70			from c11-6-17-70	Oct. 18	96 ppb	255 ppb	45 ppb	

TABLE XXIV

CLAM SAMPLE - RIVER BEAVER (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c11-11-8-70			from c11-6-17-70	Nov. 8	22 ppb	21 ppb	53 ppb	
c11-11-22-70			from c11-6-17-70	Nov. 22	14 ppb	41 ppb	22 ppb	
c11-12-6-70-1			from c11-5-9-70	Dec. 6	-------	-------	-----	
c11-12-6-70-2			from c11-5-24-70	Dec. 6	28 ppb **	24 ppb	69 ppb	
c11-12-6-70-3			from c11-5-24-70	Dec. 6	-------	-------	-----	
c11-12-6-70-4			from c11-5-24-70	Dec. 6	-------	-------	-----	
c11-12-6-70-5			from c11-5-24-70	Dec. 6	28 ppb **	24 ppb	69 ppb	
c11-12-6-70-6			from c11-5-24-70	Dec. 6	-------	-------	-----	
c11-12-6-70-7			from c11-6-17-70	Dec. 6	-------	-------	-----	
c11-12-6-70-8			from c11-6-17-70	Dec. 6	28 ppb **	24 ppb	69 ppb	

dashed line indicates no analysis made

** composite of samples c11-12-6-70-2, -5 and -8

TABLE XXV

CLAM SAMPLE - RIVER SPLIT ROCK

SITE DESCRIPTION:

LOCATION: 400 ft. upstream from bridge on highway #61 in most westerly branch.

BOTTOM: mud and silt except in riffles where gravel forms bottom.

FLOW: usually quite sluggish

TERRAIN: river splits into several meandering branches over broad flood plain, flood plain surrounded by gradually sloping hills.

VEGETATION: Alnus rugosa, Cornus stolonifera, Corylus cornuta, Betula papyrifera, Ribes sp.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons DDT(OP')	DDT(PP')	DDE	Other
c12-5-24-70	5	May 24						
c12-6-17-70	15	June 17						
c12-6-30-70			from c12-6-17-70	June 30	< .1 ppb	< .1 ppb	< .1 ppb	
c12-7-14-70			from c12-6-17-70	July 14	< .1 ppb	< .1 ppb	< .1 ppb	
c12-7-27-70			from c12-6-17-70	July 27	28 ppb	238 ppb	< .1 ppb	
c12-8-11-70			from c12-6-17-70	Aug. 11	< .1 ppb	74 ppb	< .1 ppb	
c12-8-25-70			from c12-6-17-70	Aug. 25	< .1 ppb	< .1 ppb	< .1 ppb	
c12-9-8-70			from c12-6-17-70	Sept. 8	34 ppb	< .1 ppb	< .1 ppb	
c12-9-8-70-d			from c12-8-24-70	Sept. 8	< .1 ppb	< .1 ppb	< .1 ppb	
c12-9-22-70			from c12-6-17-70	Sept. 22	< .1 ppb	< .1 ppb	< .1 ppb	Hg < .05 ppm
c12-10-4-70			from c12-6-17-70	Oct. 4	169 ppb	355 ppb	< .1 ppb	Hg .12 ppm
c12-10-18-70			from c12-6-17-70	Oct. 18	16 ppb	82 ppb	< .1 ppb	
c12-11-1-70			from c12-6-17-70	Nov. 1	97 ppb	< .1 ppb	75 ppb	

TABLE XXV

CLAM SAMPLE - RIVER SPLIT ROCK (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c12-11-8-70			from c12-6-17-70	Nov 8	< .1 ppb	< .1 ppb	< .1 ppb	
c12-11-22-70			from c12-6-17-70	Nov 22	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXVI

CLAM SAMPLE - RIVER GOOSEBERRY

SITE DESCRIPTION:

LOCATION: apx. one fourth mile upstream from bridge on highway #61.

BOTTOM: basaltic lava flows with a few large boulders and rocks.

FLOW: usually slow to sluggish in pool where clams located.

TERRAIN: river cuts deep gorge in lower reaches of river, however, where clams are located the banks are only moderately steep with some rapids.

VEGETATION: Alnus rugosa, Corylus cornuta, Rubus parviflorus, Thuja occidentalis, Picea glauca, Betula papyrifera, Ribes sp.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c13-6-15-70	15	June 15						
c13-6-29-70			from c13-6-15-70	June 29	< .1 ppb	< .1 ppb	< .1 ppb	
c13-7-13-70			from c13-6-15-70	July 13	945 ppb	4.60 ppm	< .1 ppb	
c13-7-28-70			from c13-6-15-70	July 28	< .1 ppb	< .1 ppb	< .1 ppb	
c13-8-10-70			from c13-6-15-70	Aug. 10	< .1 ppb	< .1 ppb	< .1 ppb	
c13-8-24-70			from c13-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c13-9-7-70			from c13-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c13-9-21-70			from c13-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c13-10-3-70			from c13-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c13-10-17-70			from c13-6-15-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c13-10-31-70			from c13-6-15-70	Oct. 31	250 ppb	< .1 ppb	240 ppb	
c13-11-7-70			from c13-6-15-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXVII

CLAM SAMPLE - RIVER ENCAMPMENT

SITE DESCRIPTION:

LOCATION: 100 ft. downstream from bridge on highway #61.

BOTTOM: a few boulders, large rocks and gravel covering basaltic flows.

FLOW: usually sluggish to slow except in dry weather when pools became somewhat stagnant.

TERRAIN: banks somewhat steep but vegetated.

VEGETATION: Alnus rugosa, Cornus stolonifera, Thuja occidentalis, Betula papyrifera, Abies balsamea.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c14-6-15-70	15	June 15						
c14-6-29-70			from c14-6-15-70	June 29	< .1 ppb	< .1 ppb	< .1 ppb	
c14-7-13-70			from c14-6-15-70	July 13	< .1 ppb	< .1 ppb	< .1 ppb	
c14-7-28-70			from c14-6-15-70	July 28	< .1 ppb	542 ppb	< .1 ppb	
c14-8-10-70			from c14-6-15-70	Aug. 10	< .1 ppb	< .1 ppb	< .1 ppb	
c14-8-24-70			from c14-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c14-9-7-70			from c14-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	< .05 ppm (mercury)
c14-9-21-70			from c14-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c14-10-3-70			from c14-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	17 ppb	
c14-10-17-70			from c14-6-15-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c14-10-31-70			from c14-6-15-70	Oct. 31	96 ppb	< .1 ppb	218 ppb	
c14-11-7-70			from c14-6-15-70	Nov. 7	28 ppb	58 ppb	< .1 ppb	
c14-11-21-70			from c14-6-15-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXVIII

CLAM SAMPLE - RIVER STEWART

SITE DESCRIPTION:

LOCATION: apx. one fourth mile upstream from bridge on highway #61.

BOTTOM: boulders and rocks in riffle areas, gravel and sand in pools such as the one where the clams were located.

FLOW: slow to moderate, occasionally fast.

TERRAIN: steep hills and bluffs form banks of river which consists of a series of riffles and pools.

VEGETATION: Alnus rugosa, Cornus stolonifera, Corylus cornuta, Betula papyrifera, Abies balsamea, Picea glauca.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c15-5-24-70	5	May 24						
c15-6-15-70	15	June 15						
c15-6-29-70			from c15-6-15-70	June 29	2.3 ppm	11.6 ppm	8.5 ppb	
c15-7-13-70			from c15-6-15-70	July 13	< .1 ppb	< .1 ppb	< .1 ppb	
c15-7-28-70			from c15-6-15-70	July 28	< .1 ppb	< .1 ppb	< .1 ppb	
c15-8-5-70-d			from c15-5-24-70	Aug. 5	NO ANALYSES			
c15-8-10-70			from c15-6-15-70	Aug. 10	< .1 ppb	< .1 ppb	< .1 ppb	
c15-8-24-70			from c15-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c15-9-7-70			from c15-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	< .05 ppm (mercury)
c15-9-21-70			from c15-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c15-10-3-70			from c15-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	25 ppb	
c15-10-17-70			from c15-6-15-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXIX

CLAM SAMPLE - RIVER KNIFE

SITE DESCRIPTION:

LOCATION: apx. one mile upstream from bridge on highway #61.

BOTTOM: exposed basaltic lava flows, boulders and large rocks in rapids and gravel and sand in the pools.

FLOW: usually sluggish in the pool where clams located.

TERRAIN: high steep banks along river with exposed lava flows, river is a series of rapids and pools.

VEGETATION: Alnus rugosa, Rubus parviflorus, Betula papyrifera, Acer spicatum, Thuja occidentalis, Abies balsamea, Picea glauca.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c16-5-9-70	4	May 9						
c16-5-24-70-1	5	May 24	from c16-5-9-70	May 24	< .01 ppb	< .01 ppb	< .01 ppb	
c16-5-24-70-2		May 24	from c16-5-9-70	May 24	< .01 ppb	< .01 ppb	< .01 ppb	
c16-6-14-70	15	June 14						
c16-6-22-70	7	June 22						
c16-6-29-70			from c16-6-14-70	June 29	10.6 ppb	196 ppb	< .1 ppb	
c16-6-29-70-d			from c16-6-22-70	June 29	98 ppb	11 ppm	55 ppb	
c16-7-13-70			from c16-6-14-70	July 13	970 ppb	3.66 ppm	< .1 ppb	
c16-7-28-70			from c16-6-14-70	July 28	9 ppb	< .1 ppb	23 ppb	
c16-8-10-70			from c16-6-14-70	Aug. 10	575 ppb	760 ppb	27 ppb	
c16-8-24-70			from c16-6-22-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c16-9-7-70			from c16-6-22-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c16-9-21-70			from c16-6-22-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXIX

CLAM SAMPLE - RIVER KNIFE (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons DDT(OP')	DDT(PP')	DDE	Other
c16-10-3-70			from c16-6-22-70	Oct. 3	< .1 ppb	< .1 ppb	15 ppb	
c16-10-17-70			from c16-6-14-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c16-11-6-70			from c16-6-14-70	Nov. 6	< .1 ppb	< .1 ppb	< .1 ppb	
c16-11-21-70			from c16-6-14-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c16-12-11-70-1			from c16-5-24-70	Dec. 11	-------	-------	-----	
c16-12-11-70-2			from c16-5-24-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c16-12-11-70-3			from c16-5-24-70	Dec. 11	-------	-------	-----	
c16-12-11-70-4			from c16-5-24-70	Dec. 11	-------	-------	-----	
c16-12-11-70-5			from c16-6-22-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	

dashed line indicates no analysis made

** composite of samples c16-12-11-70-2 and -5

TABLE XXX

CLAM SAMPLE - RIVER BIG SUCKER

SITE DESCRIPTION:

LOCATION: 400 yds upstream from bridge on highway 61.

BOTTOM: a few exposed basaltic lava flows, large rocks and gravel over most of river which consists mostly of riffle areas.

FLOW: moderate to fast, occasionally turbulent.

TERRAIN: banks are moderately steep and heavily vegetated.

VEGETATION: Alnus rugosa, Corylus cornuta, Betula papyrifera, Acer spicatum, Thuja occidentalis, Abies balsamea, Picea glauca, Populus tremuloides

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c17-5-24-70	5	May 24						
c17-6-14-70	15	June 14						
c17-6-22-70	15	June 22						
c17-6-29-70			from c17-6-22-70	June 29	2 ppm	< .1 ppb	170 ppb	
c17-6-29-70-1			from c17-6-22-70	June 29	48 ppb	< .1 ppb	2 ppb	
c17-7-13-70			from c17-6-22-70	July 13	< .1 ppb	1.48 ppm	< .1 ppb	
c17-7-28-70			from c17-6-22-70	July 28	< .1 ppb	< .1 ppb	25 ppb	
c17-8-10-70			from c17-6-22-70	Aug. 10	170 ppb	285 ppb	6 ppb	
c17-8-24-70			from c17-6-22-70	Aug. 24	EXTRACT LOST			
c17-9-7-70			from c17-6-22-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c17-9-21-70			from c17-6-22-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c17-10-3-70			from c17-6-22-70	Oct. 3	< .1 ppb	< .1 ppb	16 ppb	
c17-10-17-70			from c17-6-22-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXX

CLAM SAMPLE - RIVER BIG SUCKER (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c17-11-7-70			from c17-6-2[illegible]-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c17-11-21-70			from c17-6-14-70 or c17-5-24-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c17-12-11-70-1			from c17-6-14-70 or c17-5-24-70	Dec. 11	-------	-------	-----	
c17-12-11-70-2			from c17-6-14-70 or c17-5-24-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c17-12-11-70-3			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-4			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-5			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-6			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-7			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-8			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	
c17-12-11-70-9			from c17-6-14-70 or 5-24	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c17-12-11-70-10			from c17-6-14-70 or 5-24	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	

TABLE XXX

CLAM SAMPLE - RIVER BIG SUCKER (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c17-12-11-70-11			from c17-6-14-70 or 5-24	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c17-12-11-70-12			from c17-6-14-70 or 5-24	Dec. 11	-------	-------	-----	

dashed line indicates no analysis made

** composite of samples c17-12-11-70-2, -9, -10 and -11

TABLE XXXI

CLAM SAMPLE - RIVER SCHMIDT CREEK

SITE DESCRIPTION:

LOCATION: 400 ft. upstream from bridge on highway #61

BOTTOM: exposed lava flows (basaltic) with some gravel and rocks in pools.

FLOW: usually sluggish, fast occasionally and stagnant during dry weather.

TERRAIN: steep banks and exposed lava flows form banks, rather rugged relief, river is a series of pools traped behind lava flows.

VEGETATION: Alnus rugosa, Betula papyrifera, Thuja occidentalis, Abies balsamea, Taxus canadensis, Picea glauca.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c18-5-24-70	5	May 24						
c18-6-15-70	15	June 15						
c18-6-29-70			from c18-6-15-70	June 29	EXTRACT	LOST		
c18-7-13-70			from c18-6-15-70	July 13	< .1 ppb	< .1 ppb	< .1 ppb	
c18-7-28-70			from c18-6-15-70	July 28	< .1 ppb	< .1 ppb	< .1 ppb	
c18-8-10-70			from c18-6-15-70	Aug. 10	172 ppb	294 ppb	10 ppb	
c18-8-24-70			from c18-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c18-9-7-70			from c18-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c18-9-21-70			from c18-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c18-10-3-70			from c18-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c18-10-17-70			from c18-6-15-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c18-10-31-70			from c18-6-15-70	Oct. 31	49 ppb	< .1 ppb	26 ppb	
c18-11-7-70			from c18-6-15-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXI

CLAM SAMPLE - RIVER SCHMIDT CREEK (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons DDT(OP')	DDT(PP')	DDE	Other
c18-11-21-70			from c18-6-15-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c18-12-11-70-1			from c18-5-24-70	Dec. 11	-------	--------	-----	
c18-12-11-70-2			from c18-5-24-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c18-12-11-70-3			from c18-5-24-70	Dec. 11	-------	--------	-----	
c18-12-11-70-4			from c18-5-24-70	Dec. 11	-------	--------	-----	
c18-12-11-70-5			from c18-6-15-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c18-12-11-70-6			from c18-6-15-70	Dec. 11	-------	--------	-----	
c18-12-11-70-7			from c18-6-15-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	

dashed line indicates no analysis made

** composite of samples c18-12-11-70-2, -5, and -7

TABLE XXXII

CLAM SAMPLE - RIVER FRENCH

SITE DESCRIPTION:

LOCATION: 200 ft. upstream from bridge on Old North Shore Road.

BOTTOM: rocks and gravel, a few small boulders.

FLOW: usually slow to moderate current.

TERRAIN: steep banks, but not very high, eroded in some locations, river is mostly a continuous series of riffles.

VEGETATION: Alnus rugosa, Betula papyrifera, Abies balsamea, Picea glauca, Populus tremuloides.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c19-5-24-70	5	May 24						
c19-6-15-70	15	June 15						
c19-6-29-70			from c19-6-15-70	June 29	9.2 ppm	< .1 ppb	< .1 ppb	
c19-7-13-70			from c19-6-15-70	July 13	410 ppb	2.08 ppm	12 ppb	
c19-7-28-70			from c19-6-15-70	July 28	< .1 ppb	< .1 ppb	< .1 ppb	
c19-8-10-70			from c19-6-15-70	Aug. 10	22 ppb	222 ppb	< .1 ppb	
c19-8-24-70			from c19-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c19-9-7-70			from c19-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c19-9-21-70			from c19-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c19-10-3-70			from c19-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	102 ppb	
c19-10-17-70			from c19-6-15-70	Oct. 17	40 ppb	151 ppb	27 ppb	
c19-10-31-70			from c19-6-15-70	Oct. 31	86 ppb	301 ppb	< .1 ppb	
c19-11-7-70			from c19-6-15-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXII

CLAM SAMPLE - RIVER FRENCH (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c19-11-21-70			from c19-6-15-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c19-12-11-70-1			from c19-6-15-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	
c19-12-11-70-2			from c19-6-15-70	Dec. 11	< .1 ppb **	< .1 ppb	< .1 ppb	

** composite of samples c19-12-11-70-1 and -2

TABLE XXXIII

CLAM SAMPLE - RIVER TALMADGE

SITE DESCRIPTION:

LOCATION: 300 yds upstream from bridge on highway #61.

BOTTOM: exposed basaltic lava flows, gravel and rocks, a few small boulders.

FLOW: usually slow to sluggish, however during dry weather the river dried up except for a few stagnant pools.

TERRAIN: banks are quite level, the river is a series of riffles and a few small, shallow pools.

VEGETATION: Alnus rugosa, Corylus cornuta, Betula papyrifera, Populus tremuloides Populus balsamifera, Abies balsamea, Taxus canadensis.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c20-5-24-70	5	May 24						
c20-6-15-70	15	June 15						
c20-6-29-70			from c20-6-15-70	June 29	2.1 ppm	< .1 ppb	104 ppb	
c20-7-13-70			from c20-6-15-70	July 13	188 ppb	1.00 ppm	7 ppb	
c20-7-28-70			from c20-6-15-70	July 28	51 ppb	< .1 ppb	< .1 ppb	
c20-8-10-70			from c20-6-15-70	Aug. 10	62 ppb	< .1 ppb	20 ppb	
c20-8-24-70			from c20-6-15-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c20-9-7-70			from c20-6-15-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c20-9-21-70			from c20-6-15-70	Sept. 21	< .1 ppb	< .1 ppb	< .1 ppb	
c20-10-3-70			from c20-6-15-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c20-10-17-70			from c20-6-15-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c20-10-31-70			from c20-6-15-70	Oct. 31	103 ppb	402 ppb	< .1 ppb	
c20-11-7-70			from c20-6-15-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXIII

CLAM SAMPLE - RIVER TALMADGE (con't)
SITE DESCRIPTION:

Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c20-11-21-70			from c20-5-24-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXIV

CLAM SAMPLE - RIVER LESTER

SITE DESCRIPTION:

LOCATION: just off Lester River Road at first turn-off beyond golf course.

BOTTOM: exposed basaltic lava flows, boulders and rocks in rapids, gravel in pools.

FLOW: slow to sluggish, occasionally very fast.

TERRAIN: banks consist mostly of bare rock ledges and bluffs, the river is a series of pools in low spots of lava flows connected by rapids.

VEGETATION: Alnus rugosa, Betual papyrifera, Populus tremuloides, P. balsamifera, P. grandidentata, Prunus virginiana.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c22-5-26-70	5	May 26						
c22-6-14-70	15	June 14						
c22-6-29-70			from c22-6-14-70	June 29	< .1 ppb	6 ppm	< .1 ppb	
c22-7-13-70			from c22-6-14-70	July 13	78 ppb	437 ppb	6 ppb	
c22-7-28-70			from c22-6-14-70	July 28	< .1 ppb	< .1 ppb	< .1 ppb	
c22-8-10-70			from c22-6-14-70	Aug. 10	119 ppb	< .1 ppb	30 ppb	
c22-8-24-70			from c22-6-14-70	Aug. 24	34 ppb	< .1 ppb	< .1 ppb	
c22-9-7-70			from c22-6-14-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c22-9-21-70			from c22-6-14-70 or c22-5-26-70	Sept. 21	63 ppb	23 ppb	5 ppb	
c22-10-3-70			from c22-6-14-70 or 5-26	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c22-10-17-70			from c22-6-14-70 or 5-26	Oct. 17	19 ppb	78 ppb	< .1 ppb	
c22-11-6-70			from c22-6-14-70 or 5-26	Nov. 6	26 ppb	< .1 ppb	21 ppb	
c22-11-21-70			from c22-6-14-70 or 5-26	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXIV

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER LESTER (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Numbe.	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c22-12-11-70-1			from c22-6-14-70 or c22-5-26-70	Dec. 11	-------	-------	-----	
c22-12-11-70-2			from c22-6-14-70 or 5-26	Dec. 11	< .1 ppb **	< .1 ppb	28 ppb	
c22-12-11-70-3			from c22-6-14-70 or 5-26	Dec. 11	-------	-------	-----	
c22-12-11-70-4			from c22-6-14-70 or 5-26	Dec. 11	< .1 ppb **	< .1 ppb	28 ppb	
c22-12-11-70-5			from c22-6-14-70 or 5-26	Dec. 11	-------	-------	-----	
----------	----------		dashed line indicates no analysis made					
			** composite of samples		c22-12-11-70-2 and -4			

TABLE XXXV

CLAM SAMPLE - RIVER ST. LOUIS(UPPER)

SITE DESCRIPTION:

LOCATION: apx. one fourth mile above bridge on highway #2.

BOTTOM: mostly mud and sand, a few large boulders.

FLOW: usually very slow to sluggish.

TERRAIN: banks are only moderately steep and the total relief is quite level, the river flows smoothly thru this area with a minor rapids below.

VEGETATION: Corylus cornuta, Betula papyrifera, Fraxinus nigra, Salix sp. Populus tremuloides, P.balsamifera.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c23-5-26-70	5	May 26						
c23-6-14-70	15	June 14						
c23-6-29-70			from c23-6-14-70	June 29	950 ppb	2.8 ppm	6.5 ppb	
c23-7-13-70			from c23-6-14-70	July 13	68 ppb	434 ppb	8 ppb	
c23-7-26-70			from c23-6-14-70	July 26	< .1 ppb	< .1 ppb	< .1 ppb	
c23-8-10-70			from c23-6-14-70	Aug. 10	202 ppb	< .1 ppb	55 ppb	
c23-8-24-70			from c23-6-14-70	Aug. 24	27 ppb	140 ppb	< .1 ppb	
c23-9-7-70			from c23-6-14-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c23-9-21-70			from c23-6-14-70	Sept. 21	14 ppb	19 ppb	1 ppb	Hg < .05 ppm
c23-10-3-70			from c23-6-14-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c23-10-17-70			from c23-6-14-70	Oct. 17	< .1 ppb	88 ppb	< .1 ppb	
c23-10-31-70			from c23-6-14-70	Oct. 31	85 ppb	220 ppb	< .1 ppb	
c23-11-7-70			from c23-6-14-70	Nov. 7	25 ppb	64 ppb	25 ppb	

TABLE XXXV

CLAM SAMPLE -
SITE DESCRIPTION:

RIVER ST. LOUIS(UPPER) (con't)

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c23-11-21-70			from c23-6-14-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXVI

CLAM SAMPLE - RIVER ST. LOUIS(LOWER)

SITE DESCRIPTION:

LOCATION: Billings Park, Superior, at end of point by swimming beach.

BOTTOM: rock and muck.

FLOW: usually very sluggish except for wave action.

TERRAIN: high bluffs along river which is very wide at this point, location is below many of the major industries on the river.

VEGETATION: mowed grass along a brick wall, a few Acer negundo.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c24-6-14-70	15	June 14						
c24-6-29-70			from c24-6-14-70	June 29	< 1 ppb	20.6 ppm	76 ppb	
c24-7-13-70			from c24-6-14-70	July 13	33 ppb	435 ppb	4 ppb	
c24-7-26-70			from c24-6-14-70	July 26	< .1 ppb	< .1 ppb	< .1 ppb	
c24-8-10-70			from c24-6-14-70	Aug. 10	69 ppb	< .1 ppb	25 ppb	
c24-8-24-70			from c24-6-14-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c24-9-7-70			from c24-6-14-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c24-9-21-70			from c24-6-14-70	Sept. 21	20 ppb	30 ppb	< .1 ppb	
c24-10-3-70			from c24-6-14-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	Hg < .05 ppm
c24-10-17-70			from c24-6-14-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c24-10-31-70			from c24-6-14-70	Oct. 31	106 ppb	< .1 ppb	89 ppb	
c24-11-7-70			from c24-6-14-70	Nov. 7	32 ppb	84 ppb	< .1 ppb	
c24-11-21-70			from c24-6-14-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXVII

CLAM SAMPLE - RIVER NEMADJI(UPPER)

SITE DESCRIPTION:

LOCATION: 200 ft. upstream from bridge on Douglas County Rd C.

BOTTOM: clay and silt.

FLOW: usually slow, occasionally moderate, river is very turbid and silty.

TERRAIN: banks are steep and eroded red clay, a broad flood plain borders the river.

VEGETATION: Salix interior, S. sp., Fraxinus nigra.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c25-5-26-70	5	May 26						
c25-6-14-70	15	June 14						
c25-6-29-70			from c25-6-14-70	June 29	141 ppb	1.37 ppm	56.5 ppb	
c25-7-13-70			from c25-6-14-70	July 13	61 ppb	510 ppb	7 ppb	
c25-7-26-70			from c25-6-14-70	July 26	< .1 ppb	< .1 ppb	< .1 ppb	
c25-8-10-70			from c25-6-14-70	Aug. 10	106 ppb	106 ppb	19 ppb	
c25-8-24-70			from c25-6-14-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c25-9-7-70			from c25-6-14-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c25-9-21-70			from c25-6-14-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c25-10-3-70			from c25-6-14-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c25-10-17-70			from c25-6-14-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c25-10-31-70			from c25-6-14-70	Oct. 31	< .1 ppb	< .1 ppb	< .1 ppb	
c25-11-7-70			from c25-6-14-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXVIII

CLAM SAMPLE - RIVER NEMADJI(LOWER)

SITE DESCRIPTION:

LOCATION: 300 yds upstream from bridge on highway #53 in Douglas County.

BOTTOM: clay and silt.

FLOW: sluggish and very turbid and silty .

TERRAIN: very level swampy area borders river, the banks are not as badly eroded in this location as further upstream.

VEGETATION: Alnus rugosa, Cornus stolonifera, Viburnum trilobum, Rubus strigosus Prunus virginiana, Populus balsamifera, Fraxinus nigra.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c26-6-16-70	15	June 16						
c26-6-29-70			from c26-6-16-70	June 29	312 ppb	5.9 ppm	< .1 ppb	
c26-7-13-70			from c26-6-16-70	July 13	56 ppb	557 ppb	4 ppb	
c26-7-26-70			from c26-6-16-70	July 26	< .1 ppb	< .1 ppb	< .1 ppb	
c26-8-10-70			from c26-6-16-70	Aug. 10	120 ppb	115 ppb	10 ppb	
c26-8-24-70			from c26-6-16-70	Aug. 24	< .1 ppb	< .1 ppb	< .1 ppb	
c26-9-7-70			from c26-6-16-70	Sept. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c26-9-21-70			from c26-6-16-70	Sept. 21	1.02 ppm	5 ppm	146 ppb	Hg 0.19 ppm
c26-10-3-70			from c26-6-16-70	Oct. 3	< .1 ppb	< .1 ppb	< .1 ppb	
c26-10-17-70			from c26-6-16-70	Oct. 17	< .1 ppb	< .1 ppb	< .1 ppb	
c26-10-31-70			from c26-6-16-70	Oct. 31	26 ppb	46 ppb	< .1 ppb	
c26-11-7-70			from c26-6-16-70	Nov. 7	< .1 ppb	< .1 ppb	< .1 ppb	
c26-11-21-70			from c26-6-16-70	Nov. 21	< .1 ppb	< .1 ppb	< .1 ppb	

TABLE XXXVIII

CLAM SAMPLE - RIVER MENADJI(LOWER) (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
c26-12-11-70-1			from c26-6-16-70	Dec. 11	32 ppb **	42 ppb	< .1 ppb	
c26-12-11-70-2			from c26-6-16-70	Dec. 11	-------	-------	-----	
c26-12-11-70-3			from c26-6-16-70	Dec. 11	32 ppb **	42 ppb	< .1 ppb	

dashed line indicates no analysis made

** composite of samples c26-12-11-70-1 and -3

TABLE XXXIX

CLAM SAMPLE - RIVER MISSISSIPPI (CONTROL)

SITE DESCRIPTION:

LOCATION: Deer River, Minnesota.

BOTTOM:

TERRAIN:

FLOW:

VEGETATION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
1cx-5-3-70				May 3	< .01 ppm	< .01 ppm	< .01 ppm	
2cx-5-3-70				May 3	.4 ppm	.2 ppm	< .01 ppm	
3cx-5-3-70				May 3	.02 ppm	.02 ppm	< .01 ppm	
4cx-5-3-70				May 3	.02 ppm	.01 ppm	< .01 ppm	
5cx-5-3-70				May 3	.01 ppm	< .01 ppm	< .01 ppm	
6cx-5-3-70				May 3	.01 ppm	.01 ppm	< .01 ppm	
7cx-5-3-70				May 3	.07 ppm	.05 ppm	< .01 ppm	
8cx-5-3-70				May 3	.03 ppm	.02 ppm	.50 ppm	
9cx-5-3-70				May 3	.25 ppm	.50 ppm	.30 ppm	
10cx-5-3-70				May 3	.04 ppm	.10 ppm	< .01 ppm	
11cx-5-3-70				May 3	.02 ppm	.09 ppm	< .01 ppm	
12cx-6-8-70				June 8	3.25 ppb	14.75 ppb	1.25 ppb	
13cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	

TABLE XXXIX

CLAM SAMPLE - RIVER MISSISSIPPI (CONTROL) (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
14cx-6-8-70				June 8	100 ppb	232.3 ppb	18.1 ppb	
15cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	
16cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	
17cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	
18cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	
19cx-6-8-70				June 8	0.9 ppb	6.3 ppb	1.3 ppb	
20cx-6-8-70				June 8	60.7 ppb	< .01 ppb	41.2 ppb	
21cx-6-8-70				June 8	0.40 ppb	2.90 ppb	0.60 ppb	
22cx-6-8-70				June 8	< .01 ppb	273 ppb	< .01 ppb	
23cx-6-8-70				June 8	< .01 ppb	< .01 ppb	26.3 ppb	
24cx-6-8-70				June 8	10 ppb	38.7 ppb	6.0 ppb	
25cx-6-8-70				June 8	36.3 ppb	150.4 ppb	28.1 ppb	
26cx-6-8-70				June 8	< .01 ppb	< .01 ppb	< .01 ppb	

TABLE XXXIX

CLAM SAMPLE - RIVER MISSISSIPPI (CONTROL) (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
27cx-6-8-70				June 8	17.7 ppm	21.1 ppm	4.2 ppm	
28cx-6-8-70				June 8	165.0 ppb	151.4 ppb	19.4 ppb	
29cx-6-8-70				June 8	163.3 ppb	387.0 ppb	5.8 ppb	
30cx-6-8-70				June 8	137.9 ppb	297.7 ppb	15.4 ppb	
31cx-6-8-70				June 8	164.2 ppb	776.5 ppb	14.6 ppb	
32cx-6-8-70				June 8	69.3 ppb	505.5 ppb	< .01 ppb	
33cx-6-8-70				June 8	< .01 ppb	143.2 ppb	< .01 ppb	
34cx-6-8-70				June 8	180.4 ppb	478.6 ppb	< .01 ppb	
35cx-6-8-70				June 8	190 ppb	1.08 ppm	17.9 ppb	
36cx-6-8-70				June 8	138.8 ppb	< .01 ppb	14.6 ppb	
37cx-6-8-70				June 8	795.5 ppb	< .01 ppb	< .01 ppb	
38cx-6-8-70				June 8	300.0 ppb	908 ppb	< .01 ppb	
39cx-6-12-70				June 12	< .1 ppb	.5 ppm	< .1 ppb	

TABLE XXXIX

CLAM SAMPLE - RIVER MISSISSIPPI (CONTROL) (con't)
SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other
40cx-6-12-70				June 12	< .1 ppb	< .1 ppb	< .1 ppb	
41cx-6-12-70				June 12	< .1 ppb	< .1 ppb	< .1 ppb	
42cx-6-12-70				June 12	< .1 ppb	< .1 ppb	< .1 ppb	
43cx-6-12-70				June 12	< .1 ppb	< .1 ppb	< .1 ppb	
44cx-6-12-70				June 12	< .1 ppb	1 ppm	4 ppb	
45cx-6-26-70				June 26	< .1 ppb	< .1 ppb	< .1 ppb	
46cx-6-26-70				June 26	< .1 ppb	< .1 ppb	< .1 ppb	
47cx-6-26-70				June 26	17 ppb	178 ppb	< .1 ppb	
48cx-6-26-70				June 26	42 ppb	< .1 ppb	< .1 ppb	
49cx-6-26-70				June 26	< .1 ppb	< .1 ppb	< .1 ppb	
50cx-6-26-70				June 26	24 ppb	155 ppb	1.4 ppb	
51cx-6-26-70				June 26	46 ppb	151 ppb	2 ppb	

TABLE XXXX

CLAM SAMPLE - NATIVE CLAMS RIVER ST. LOUIS (UPPER)

SITE DESCRIPTION:

LOCATION: apx one fourth mile above bridge on highway #2.

BOTTOM: mostly mud and sand, a few large boulders.

FLOW: usually very slow to sluggish.

TERRAIN: banks are only moderately steep and the total relief is quite level, the river flows smoothly thru this area with a minor rapids below.

VEGETATION: Corylus cornuta, Betula papyrifera, Fraxinus nigra, Salix sp., Populus tremuloides, P. balsamifera.

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other (Aldrin)
c23-7-10-70-1			native clam #1	July 10				
c23-7-10-70-2			native clam #2	July 10				
c23-7-10-70-3			native clam #3	July 10				
c23-7-10-70-4			native clam #4	July 10				
c23-7-10-70-5			native clam #5	July 10				
c23-7-10-70-6			native clam #6	July 10				
c23-7-26-70-7			native clam #7	July 26	130	700	1	410
c23-7-26-70-8			native clam #8	July 26	46	260	<1	10670
c23-7-26-70-9			native clam #9	July 26	27	93	30	270
c23-8-10-70-10			native clam #10	Aug. 10	52	241	18	290
c23-8-10-70-11			native clam #11	Aug. 10	130	249	<1	700
c23-8-10-70-12			native clam #12	Aug. 10	80	770	12	62
c23-8-24-70-13			native clam #13	Aug. 24	54	610	35	57

TABLE XXXX:

CLAM SAMPLE - NATIVE CLAMS RIVER ST. LOUIS (UPPER) (con't)

SITE DESCRIPTION:

+Field Number	Number of Clams "Planted"	Date "Planted"	Number of Clams Retrieved and Field Number	Date Retrieved	Analytical Data Chlorinated Hydrocarbons			
					DDT(OP')	DDT(PP')	DDE	Other (Aldrin)
c23-8-24-70-14			native clam #14	Aug. 24	28	210	4	52
c23-8-24-70-15			native clam #15	Aug. 24	140	340	75	145
c23-9-7-70-16			native clam #16	Sept. 7	180	340	87	382
c23-9-7-70-17			native clam #17	Sept. 7	60	300	16	527
c23-9-7-70-18			native clam #18	Sept. 7	78	370	10	58
c23-9-21-70-19			native clam #19	Sept. 21	34	210	2	13
c23-9-21-70-20			native clam #20	Sept. 21	190	240	15	186
c23-9-21-70-21			native clam #21	Sept. 21	30	---	56	338
c23-10-3-70-22			native clam #22	Oct. 3	110	456	15	36
c23-10-3-70-23			native clam #23	Oct. 3	74	460	1	139
c23-10-3-70-24			native clam #24	Oct. 3	910	1630	105	< 1

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAM

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Control (3146-3147)	1	Lampsilis ventricosa	10	63
	2		16	79
	3		16	77
	4		11	42.6
Field Numbers 1cx-5-3-70 to 11cx-5-3-70	5		11	41.7
	6	Ligumia recta	14	32.7
	7	Lampsilis ventricosa	11	32.0
	8		11	31.5
	9		11	32.0
	10		10	28.5
	11	Lampsilis siliquoidea	8	11.3
Control (5282)	12X-1	Ligumia recta	12	23.0
	13X-2	Lampsilis ventricosa	17	77.2
	14X-3	Lampsilis siliquoidea	10	20.0
	15X-4		10	19.4
	16X-5	Ligumia recta	13	55.9
	17X-6	Lampsilis siliquoidea	10	26.6
	18X-7		13	24.6
	19X-8		10	20.5
	20X-9	Lampsilis ventricosa	10	48.5
Field Numbers 12cx-6-8-70 to 38cx-6-8-70	21X-10		17	75.3
	22X-11	Lampsilis siliquoidea	9	25.7
	23X-12	Ligumia recta	11	27.2
	24X-13		13	51.7
	25X-14	Lampsilis ventricosa	11	68.3
	26X-15	Ligumia recta	12	45.9
	27X-16	Lampsilis siliquoidea	12	20.9
	28X-17	Ligumia recta	13	30.0
	29X-18	Lampsilis ventricosa	14	33.3
	30X-19	Ligumia recta	11	24.7
	31X-20	Lampsilis ventricosa	11	40.2
	32X-21	Lampsilis siliquoidea	12	18.8
	33X-22	Ligumia recta	14	49.9
	34X-23	Lampsilis siliquoidea	12	25.1
	35X-24		11	16.8
	36X-25		10	19.4
	37X-26		8	14.6
	38X-27	Ligumia recta	13	13.0

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Control (5872)	1-39X	Lampsilis ventricosa	19	41.8
	2-40X	Ligumia recta	11	24.7
	3-41X		18	27.8
Field Numbers	4-42X	Lampsilis siliquoidea	10	17.0
39cx-6-12-70	5-43X	Lampsilis ventricosa	10	27.2
to	6-44X		10	29.4
44cx-6-12-70				
Control (6736)	45Cx	Ligumia recta	11	33.3
	46CX	Lampsilis ventricosa	11	55.3
	47CX		11	35.9
Field Numbers	48CX	Lampsilis siliquoidea	10	20.2
45cx-6-26-70	49CX	Lampsilis ventricosa	11	38.4
to	50CX	Ligumia recta	11	35.0
51cx-6-26-70	51CX	Lampsilis ventricosa	14	44.5

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Control (3146-3147)	1	Lampsilis ventricosa	10	63
	2		16	79
	3		16	77
	4		11	42.6
Field Numbers	5		11	41.7
	6	Ligumia recta	14	32.7
1cx-5-3-70	7	Lampsilis ventricosa	11	32.0
to	8		11	31.5
11cx-5-3-70	9		11	32.0
	10		10	28.5
	11	Lampsilis siliquoidea	8	11.3
Control (5282)	12X-1	Ligumia recta	12	23.0
	13X-2	Lampsilis ventricosa	17	77.2
	14X-3	Lampsilis siliquoidea	10	20.0
	15X-4		10	19.4
	16X-5	Ligumia recta	13	55.9
	17X-6	Lampsilis siliquoidea	10	26.6
	18X-7		13	24.6
	19X-8		10	20.5
	20X-9	Lampsilis ventricosa	10	48.5
Field Numbers	21X-10		17	75.3
	22X-11	Lampsilis siliquoidea	9	25.7
12cx-6-8-70	23X-12	Ligumia recta	11	27.2
to	24X-13		13	51.7
38cx-6-8-70	25X-14	Lampsilis ventricosa	11	68.3
	26X-15	Ligumia recta	12	45.9
	27X-16	Lampsilis siliquoidea	12	20.9
	28X-17	Ligumia recta	13	30.0
	29X-18	Lampsilis ventricosa	14	33.3
	30X-19	Ligumia recta	11	24.7
	31X-20	Lampsilis ventricosa	11	40.2
	32X-21	Lampsilis siliquoidea	12	18.8
	33X-22	Ligumia recta	14	49.9
	34X-23	Lampsilis siliquoidea	12	25.1
	35X-24		11	16.8
	36X-25		10	19.4
	37X-26		8	14.6
	38X-27	Ligumia recta	13	13.0

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weights (Grams)
Experimental Lab #154	C-1	Lampsilis siliquoidea	11	19.0
	C-2	Lampsilis ventricosa	12	44.5
	C-3(b)	Ligumia recta	19	35.5
	C-4(e)	Lampsilis ventricosa	12	25.0
	C-6(b)	Ligumia recta	19	25.0
	C-7(c)		12	26.5
	C-8(a)		16	31.5
	C-9(a)	Lampsilis ventricosa	12	48.0
	C-10(b)	Ligumia recta	16	33.0
Field Numbers	C-11(a)	Lampsilis ventricosa	12	31.0
	C-12	Lampsilis siliquoidea	14	26.0
	C-13	Ligumia recta	16	33.0
1-8-25-70	C-14		13	35.5
to	C-15(a)		13	18.0
26-8-24-70	C-16(b)		16	20.5
	C-17(b)	Lampsilis siliquoidea	12	16.0
	C-18(a)	Lampsilis ventricosa	12	47.0
	C-19(a)		13	32.0
	C-20(b)	Ligumia recta	13	17.0
	C-22(a)	Lampsilis ventricosa	12	25.0
	C-23	Ligumia recta	12	17.0
	C-24	Lampsilis ventricosa	13	42.0
	C-25	Ligumia recta	14	21.0
	C-26(a)		16	27.0
Experimental Lab #6735	C-1	Ligumia recta	12	29.0
	C-2		12	23.5
	C-3(a)		12	28.0
	C-4	Lampsilis ventricosa	12	64.7
	C-6(a)	Ligumia recta	12	32.0
	C-7(a)		13	26.0
Field Numbers	C-8		12	32.0
	C-9(a)	Lampsilis ventricosa	11	41.5
C1-6-30-70	C-10(a)	Ligumia recta	12	26.0
to	C-11(a)	Lampsilis ventricosa	11	45.7
C26a-6-29-70	C-12	Lampsilis siliquoidea	11	24.1
	C-13	Ligumia recta	16	33.1
	C-14		13	28.8
	C-15(a)		16	14.7
	C-16(b)		16	30.9
	C-16(b2)	Lampsilis siliquoidea	13	10.3
	C-17(b1)		10	17.8
	C-17(b3)		10	7.0

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April – December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #6735	C-18	Ligumia recta	12	29.5
	C-19(a)		11	14.1
	C-20(a)	Lampsilis ventricosa	12	14.2
	C-22(a)		14	30.6
	C-23	Ligumia recta	14	15.6
	C-24	Lampsilis ventricosa	16	45.7
	C-25		11	54.0
	C-26(a)	Ligumia recta	15	33.7
Experimental Lab #7655	C-1	Ligumia recta	14	23.0
	C-2		12	20.5
	C-3(a)		15	24.0
	C-4(a)	Lampsilis ventricosa	12	14.5
	C-6(a)	Ligumia recta	16	19.0
	C-7(a)		11	22.0
	C-8(a)		15	28.0
	C-9(a)	Lampsilis ventricosa	11	36.0
Field Numbers	C-10(a)		14	27.7
	C-11(a)	Ligumia recta	11	13.5
	C-12	Lampsilis siliquoidea	14	15.0
1-7-14-70	C-13	Ligumia recta	15	28.0
to	C-14		15	31.5
26a-7-15-70	C-15(a)		16	31.0
	C-16(b)	Lampsilis siliquoidea	10	17.0
	C-17(b)		9	16.0
	C-18		14	30.5
	C-19(a)	Ligumia recta	12	28.0
	C-20(a)		12	23.0
	C-22(a)	Lampsilis ventricosa	12	68.9
	C-23		15	114.8
	C-24		13	55.6
	C-25		12	68.4
	C-26(a)		15	57.3
Experimental Lab #5855	C-2	Lampsilis ventricosa	15	36.0
	C-6(b)	Ligumia recta	16	28.9
	C-8(a)	Lampsilis siliquoidea	12	18.4
	C-12	Lampsilis ventricosa	11	35.2
Field Numbers	C-13	Lasmigonia complanata	20	47.6
	C-14	Ligumia recta	20	51.0
C2-11-1-70	C-18(a)	Lampsilis ventricosa	12	25.3
to	C-19(a)		13	47.1
C26a-10-31-70	C-20(b)	Ligumia recta	12	19.3

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #3855	C-23	Ligumia recta	12	22.8
	C-24	Lampsilis ventricosa	13	41.0
	C-25		13	37.0
	C-26(a)	Ligumia recta	18	42.0
Experimental Lab #5727	C-2	Lampsilis ventricosa	14	18.4
	C-3(b)	Ligumia recta	11	17.4
	C-4(a)		15	35.0
	C-6(b)		15	29.5
	C-8(a)	Lampsilis siliquoidea	12	14.3
	C-9(b)	Lampsilis ventricosa	18	32.3
	C-10(b)	Ligumia recta	12	17.8
Field Numbers	C-11(a)		13	17.3
	C-12		13	22.8
C2-11-8-70	C-13	Lampsilis siliquoidea	11	16.7
to	C-14	Lampsilis ventricosa	12	33.4
C26a-11-7-70	C-16(b)		11	23.7
	C-17(b)	Lampsilis siliquoidea	10	11.5
	C-18(a)		9	18.7
	C-19(a)	Ligumia recta	11	17.3
	C-20(c)		14	25.6
	C-22(b)		11	19.4
	C-23		18	31.7
	C-24	Lampsilis ventricosa	13	24.4
	C-25		13	40.3
	C-26(a)	Ligumia recta	11	24.3
Experimental Lab #5728	C-2	Ligumia recta	15	26.3
	C-3(b)	Lampsilis ventricosa	7	20.4
	C-6(b)	Ligumia recta	14	24.5
	C-10(b)	Lampsilis ventricosa	13	24.9
Field Numbers	C-11(a)	Ligumia recta	12	20.2
	C-12	Lampsilis ventricosa	11	20.0
C2-11-22-70	C-14		12	25.0
to	C-16(b)	Ligumia recta	13	27.7
C26a-11-21-70	C-17(b)	Lampsilis ventricosa	13	25.2
	C-18(a)	Ligumia recta	12	17.6
	C-19(a)		12	19.2
	C-20(c)	Lampsilis ventricosa	12	40.0
	C-22(b)	Ligumia recta	12	25.6
	C-23		17	35.8
	C-24	Lampsilis ventricosa	11	30.4
	C-26(a)	Ligumia recta	11	38.9

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #5729	C-16(b2)	Lampsilis ventricosa	14	36.0
	C-16(b5)	Lampsilis siliquoidea	10	12.7
	C-17(b2)	Lampsilis ventricosa	14	26.4
	C-17(b9)	Lampsilis siliquoidea	13	10.9
Field Numbers	C-17(b10)	Ligumia recta	12	16.2
	C-17(b11)		12	26.8
C16b-12-11-70	C-17(a2)		12	21.9
to	C-18(a5)		12	23.1
C26a-12-11-70	C-18(a7)		17	27.0
	C-19(a1)		13	22.5
	C-19(a2)		13	21.2
	C-22(b2)	Lampsilis ventricosa	12	33.2
	C-22(b4)	Ligumia recta	12	22.1
	C-26(a1)	Lampsilis ventricosa	13	36.1
	C-26(a3)	Ligumia recta	13	33.6
Experimental Lab #6427	C-2(2)	Ligumia recta	15	23.4
	C-2(3)	Lampsilis ventricosa	12	35.4
	C-3(b2)		11	17.1
	C-3(b3)	Ligumia recta	11	18.2
	C-6(b1)		11	17.6
Field Numbers	C-6(b4)	Lampsilis siliquoidea	10	13.3
	C-6(b6)		10	12.5
(Composite sample - see individual rivers)	C-9(b3)	Lampsilis ventricosa	11	35.7
	C-9(b7)		15	38.2
	C-9(b10)	Ligumia recta	12	20.2
	C-9(b14)	Lampsilis ventricosa	15	37.6
	C-11(a2)		5	10.5
	C-11(a5)	Ligumia recta	17	33.2
	C-11(a8)		11	21.4
Experimental Lab #946	C-1	Ligumia recta	11	31.5
	C-2	Lampsilis ventricosa	10	30.0
	C-3(b)	Ligumia recta	13	28.0
Field Numbers	C-4(a)	Lampsilis siliquoidea	10	15.0
	C-6(b)	Ligumia recta	11	16.5
C1-9-8-70	C-7(c)		15	31.5
to	C-8(a)	Lampsilis ventricosa	12	36.5
C26a-9-7-70	C-9(b)		15	48.5
	C-10(b)	Ligumia recta	12	25.0
	C-11(a)	Lampsilis siliquoidea	10	14.5

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #946	C-12(dead)	Ligumia recta	14	24.5
	C-12		12	35.5
	C-13		10	36.5
	C-14		11	21.0
	C-15(a)	Lampsilis ventricosa	11	29.5
	C-16(b)	Ligumia recta	13	34.5
	C-17(b)	Lampsilis siliquoidea	11	22.0
(Con't.)	C-18(a)	Ligumia recta	17	32.5
	C-19(a)		16	34.5
	C-20(b)	Lampsilis ventricosa	12	35.5
	C-22(a)		11	41.0
	C-23		11	38.0
	C-24		12	52.0
	C-25	Ligumia recta	16	32.0
	C-26(a)	Lampsilis ventricosa	13	58.0
Experimental Lab #2875	C-1	Ligumia recta	12	27.0
	C-2	Lampsilis ventricosa	13	51.5
	C-3(b)	Lampsilis siliquoidea	14	19.5
	C-4(a)	Ligumia recta	12	26.5
	C-6(b)		12	19.5
	C-7(d)		14	25.0
	C-8(a)		12	27.0
Field Numbers	C-9(b)	Lampsilis ventricosa	12	60.5
	C-10(b)		10	22.0
C1-10-4-70	C-11(a)	Ligumia recta	13	24.5
to	C-12		13	28.5
C26a-10-3-70	C-13		17	41.5
	C-14		16	28.0
	C-15(a)		11	31.5
	C-16(b)		12	29.0
	C-17(b)	Lampsilis siliquoidea	10	24.0
	C-18(a)	Ligumia recta	10	27.0
	C-19(a)		11	31.0
	C-20(b)		12	26.0
	C-22	Lampsilis ventricosa	13	32.5
	C-23		13	40.0
	C-24		11	35.0
	C-25		15	52.0
	C-26(a)		11	34.0

TABLE XXXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #9260	C-1	Ligumia recta	12	30
	C-2	Lampsilis ventricosa	10	53.5
	C-3(a)	Ligumia recta	12	36.5
	C-4(a)		11	35.0
	C-6(b)		11	34.0
	C-7(a)		11	30.0
	C-8(a)		12	36.5
	C-9(b)	Lampsilis ventricosa	15	69.0
	C-10(b)		11	46.5
	C-11(a)	Lampsilis siliquoidea	11	25.0
	C-12	Ligumia recta	11	23.5
	C-13	Lampsilis ventricosa	11	44.0
	C-14		--	34.0
Field Numbers	C-15(a)	Ligumia recta	12	36.0
	C-16(b)		12	23.0
	C-17(b)	Lampsilis siliquoidea	11	17.0
C1-7-27-70	C-18(a)	Lampsilis ventricosa	12	24.5
to	C-19(a)		10	24.5
C26a-7-26-70	C-20(a)	Lampsilis siliquoidea	14	20.5
	C-22(a)	Lampsilis ventricosa	11	31.0
	C-23		12	34.5
	C-24		10	32.0
	C-25		11	34.0
	C-26(a)		12	44.5
Experimental Lab #9274	C-1	Ligumia recta	14	26.0
	C-2	Lampsilis siliquoidea	10	20
	C-3(a)	Ligumia recta	14	25.0
	C-4(a)		11	22.5
	C-6(b)		11	21.0
	C-7(c)	Lampsilis siliquoidea	8	23.0
	C-8(a)	Ligumia recta	13	26.5
Field Numbers	C-9(b)	Lampsilis ventricosa	11	33.0
	C-10(b)	Ligumia recta	11	22.0
	C-11(a)		14	29.5
C15a-8-5-70	C-12		11	24.5
to	C-13		10	24.0
C26a-8-10-70	C-14		10	19.0
	C-15(a)		13	26.0
	C-16	Lampsilis siliquoidea	11	28.5
	C-17		10	23.0
	C-18	Lampsilis ventricosa	11	62.5
	C-19(a)	Ligumia recta	11	22.5

TABLE XXXI

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Experimental Lab #5273 1-5-23-70	1	Ligumia recta	13	11.8(comp.)
	2	Anodonta marginata	13	
Lab #5274 10-5-24-70	1	Ligumia recta	12	10.8(comp.)
	2	Lampsilis ventricosa	12	
Lab #5275 11-5-24-70	1	Lampsilis siliquoidea	10	10.0(comp.)
	2	Ligumia recta	14	
Lab #5276 16-5-24-70	1	Lampsilis siliquoidea	13	10.9(comp.)
	2	Lampsilis ventricosa	19	

TABLE XXXII

SUMMARY OF AGE, WEIGHT, AND SPECIES

OF CLAMS

April - December

1970

Clam Category	Specimen Number	Species	Number of Growth Rings	Weight (Grams)
Native Clams (Control #9172)	CN23(7)	Lampsilis siliquoidea	7	3.5
	CN23(8)		6	3.5
	CN23(9)		5	3.0
	CN23(10)		7	5.5
	CN23(11)		9	10.5
	CN23(12)		9	13.5
	CN23(13)		8	12.0
Field Numbers	CN23(14)		9	12.0
	CN23(15)		7	8.5
	CN23(16)		7	7.0
C23-7-10-70(1)	CN23(17)		7	5.5
to	CN23(18)		7	5.5
C23-10-5-70(24)	CN23(19)		8	9.0
(See Table XXXXI)	CN23(20)		11	13.0
	CN23(21)		9	11.5
	CN23(22)		8	7.5
	CN23(23)		8	8.5
	CN23(24)		10	18.0

TABLE XXXXII

CHLORINATED HYDROCARBON PESTICIDES IN CLAMS EXPOSED IN NORTH SHORE STREAMS

Median Values in Parts per Billion (ppb)

	OP'DDT	PP'DDT	DDE
Controls	17	20	10
RIVERS			
Pigeon	< .1	< .1	< .1
Reservation	< .1	< .1	< .1
Brule	< .1	131	< .1
Devil Track	7.5	< .1	< .1
Cascade	< .1	< .1	< .1
Poplar	< .1	< .1	< .1
Temperance	< .1	< .1	< .1
Manitou	< .1	< .1	< .1
Baptism	< .1	< .1	< .1
Beaver	28	32	9.5
Split Rock	< .1	< .1	< .1
Gooseberry	< .1	< .1	< .1
Encampment	< .1	< .1	< .1
Stewart	< .1	< .1	< .1
Knife	< .1	< .1	< .1
Big Sucker	< .1	< .1	< .1
Schmidt Creek	< .1	< .1	< .1
French	< .1	< .1	< .1
Talmadge	< .1	< .1	< .1
Lester	< .1	< .1	< .1
Upper St. Louis	19	41	< .1
Lower St. Louis	< .1	< .1	< .1
Upper Nemadji	< .1	< .1	< .1
Lower Nemadji	13	21	< .1

1 Accession Number	2 Subject Field & Group	SELECTED WATER RESOURCES ABSTRACTS INPUT TRANSACTION FORM
W	05B	

5 Organization: Minnesota Pollution Control Agency
717 Delaware St. S. E.
Minneapolis, Minnesota 55440

6 Title: Pesticide Inputs and Levels
Minnesota Water - Lake Superior Basin

10 Author(s): Odlaug, Theron O.
Olson, Theodore A.

16 Project Designation: 16050 EYT

21 Note:

22 Citation:

23 Descriptors (Starred First)

Pesticide levels in Lake Superior, Source of Lake Superior pesticides.

25 Identifiers (Starred First)

Organochlorine pesticides, DDT, Isomers of DDT

27 Abstract: Field and laboratory studies were conducted to determine whether North Shore streams in the Minnesota drainage basin of Lake Superior were important as contributors of insecticides. Samples were collected and analyzed from selected streams, the Grand Marais and Duluth Pumping Stations, and the Duluth sewage treatment plant. Clams were exposed for bioassay purposes in 22 streams.

Under conditions of normal flow, very little insecticide contamination was being contributed to Lake Superior by these streams. Highest values occurred in samples from the Lester and Lower St. Louis Rivers and in sewage effluent. In October, following heavy runoff, PP'DDT reached concentrations of 20-21.8 ppb. Ordinarily, median levels in these rivers were 0.03 and 0.02 ppb, respectively. Medians in all other streams were less than 0.01 ppb. Almost invariably PP'DDT was present in greater concentrations than its OP' isomer or DDE.

In the clam studies PP'DDT values exceeded the median in four streams only. Native clams from the St. Louis River, with a resident time of 5-11 years, had accumulated appreciable concentrations of PP'DDT. Values ranged from 93 to 1630 ppb.

On this basis, it was recommended that the St. Louis River be monitored at reasonable intervals.

Abstractor: Theron O. Odlaug
Theodore A. Olson

Institution: University of Minnesota

WR 102 (REV. JULY 1969)
WRSIC

SEND, WITH COPY OF DOCUMENT, TO: WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D. C. 20240

U.S. GOVERNMENT PRINTING OFFICE: 1972